AMUSEMENT RIDE INCIDENT OF JUNE 21, 2007
SIX FLAGS KENTUCKY KINGDOM, LOUISVILLE KENTUCKY

FINAL REPORT
OF THE KENTUCKY DEPARTMENT OF AGRICULTURE
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BACKGROUND

At approximately 4:56 p.m. on Thursday, June 21, 2007, at Six Flags Kentucky Kingdom (SFKK) located at 937 Phillips Lane in Louisville, Kentucky, an injury accident occurred on the giant drop ride called the Superman Tower of Power (STP), formerly known as the Hellevator. The injured minor female was riding in car #3, seat 4. The injured girl was with two other minor females, riding in seats 2 and 3. Seat 1 was empty. For purposes of this report, the minors will be identified as the injured girl, seat 2 minor, and seat 3 minor[1]. The weather was clear and sunny and was not a factor in the accident.

INJURY ACCIDENT

During the operation of the giant drop ride[2], the passenger car was lifted to the top of the ride by a carrier. The carrier is connected to the lifting system by two wire ropes. While the car was being lifted, the right side wire rope failed when the passenger car was approximately 35 to 45 feet from the bottom of the ride. Immediately after the failure occurred the top portion of the broken cable fell to the inside of the tower, while the lower portion fell to the outside of the tower. The carrier and passenger car continued to the top of the ride, which was approximately one-hundred thirty-one (131) feet from the bottom of the ride. When the carrier reached the top of the tower, the passenger car was released from the carrier, resulting in a normal freefall function. As the passenger car quickly descended, the lower portion of the broken cable on the outside of the tower severed portions of the injured girl's left and right legs above the feet. The injured girl's left femur was also broken. Seat 2 minor and seat 3 minor suffered minor injuries.

PAST INSPECTIONS OF STP

Pursuant to Kentucky Revised Statutes Chapter 247, the Kentucky Department of Agriculture, Office of Consumer and Environmental Protection, Division of Regulation and Inspection, Amusement Rides Branch, is charged with the responsibility of regulating the operation of amusement rides and attractions in Kentucky.

The record retention schedule, as determined by the Kentucky Department for Libraries and Archives, dictates that series # 04303 files [Amusement Rides Inspection and License File] must be maintained for three years after the expiration of the permit and thereafter destroyed. The KDA has records of inspections on the STP for the years 2003-2007[3]. During these years the STP was inspected in the following manner (any exceptions are noted):

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[1] KDA seat reference and section reference
[2] Tower technical drawing
[3] KDA inspection documents for the Superman Tower of Power

- Shut off power to ride. Lock out and tag out. Open all motor drives in power house. Inspect electrical conditions inside drives and inside control panel. Inspect air compressor tank, airlines and electrical connections and wiring.
- Inspect queue line area for proper signage and that signs are secured. Inspect conditions of posts and handrails for looseness and missing parts. Inspect walkway areas for trip hazards. Visually inspect overall area of ride, top to bottom. Inspect security fence around riders' area. Inspect gates at entrance and exit areas. Check to see that gates are operating properly.
- Inspect the carrier fiberglass coverings. Inspect the under part of carriers. Inspect behind carrier frames. Inspect lap bar connections and attachments and condition of lap bars and straps. Inspect where carriers are attached to frame, where magnets are attached to frame on the inside rail. Inspect load sensor rams for all electrical and switch connections. Inspect bottom rails.
- Inspect catch wagon fiberglass covering. Inspect catch wagon metal frame. Inspect mechanical parts where catch wagon connects to carriers. Inspect where cable swedges attach to catch wagon. Inspect cable area where attached to swedges. Inspect where brake fins attach to rail. Inspect for proper attachment of switches and electrical wiring. Repeat until all five carriers are inspected.
- Return power to ride. Inspect operation of opening and closing of lap bars and crotch straps. Check switch stand in front of seats to verify that lap bars are closed and carriers are ready to launch. This inspection is performed on all five carriers.
- Inspect all emergency stop switches. Inspect stop switches on entrance and exit gates.
- Inspect top of tower house. Visually inspect from bottom to top of ride. Inspect winch housings at the top starting at floor level between housings. Inspect behind winch housings to outer wall of tower, moving between winch housings until all five winch housings are inspected. Inspect top of winch housings and electrical motor mountings, electrical wirings, switches, and overlap roller, moving from one to the other housing until all five are done. Inspect center area of top tower house by inspecting electrical motor brake, lining and mechanical parts on winch drum brake. Inspect all air lines to drum brake. Visually inspect cable on drum and drum area. Run winches in maintenance mode operating carriers up and down the tower. Visually inspect the cables as they move over the drum and randomly checking with glove if the cable is greased for operation or a rag if the cable is clean as the cable goes through the floor on the counter weight side. Also check the operation of the winch drum brake. Check the sections of cable for smoothness. Operate and inspect all five winch housings this way. At the bottom of the ride, run the ride and inspect operation of all emergency switches. After emergency stopping ride, inspect operation of auxiliary power generator for use of evacuation in loss of power.
- Inspect inside bottom of tower, inspecting cable and cable swedges where connected to counter weight.

The 2003 inspection notes reflect that the cable lift motors, bearings, swedge lock and drive motors were all rebuilt or replaced and were back in the top of the ride. The 2004

inspection notes reflect that new cables that were to be installed 2005 were installed in 2003. The 2005, 2006, and 2007 reports do not mention the cables or section III. KDA Inspector Gary Wheeler performed the inspections of the STP ride for each of the years 2003-2007 and remembered nothing noteworthy about the cables between their installation and the incident.

For the 2007 inspection, the KDA inspector spot checked the cables on sections II, III, IV, and V. The cables on section I had been replaced with new cables prior to the inspection. Because the STP was presented to the inspector in operational condition, the spot checks on sections II-V were conducted with a leather glove, due to the volume of grease on the cables. The inspector determined a rag test would not be useful during this particular inspection because the grease on the cables would quickly fill the rag with grease, making broken wire detection impossible. The spot checks were performed with the drums and sieves operating at low speed in maintenance mode. Even with the drums and motors running at low speed, this inspection is extremely dangerous for anybody who places his hands on the cable because of the possibility that the person's hand may get caught in the drum. The inspector did not find cable breaks on any section of the ride.

INVESTIGATION

INVESTIGATION DAY 1

The incident was reported to the KDA by a phone call to Inspector Gary Wheeler at 5:45 p.m. on Thursday, June 21, 2007. Inspector Wheeler called Branch Manager Chad Halsey and Inspector Justin Bruner. Inspector Bruner was the first KDA representative to arrive at the scene of the incident and waited until Inspector Wheeler arrived. Inspectors Wheeler and Bruner secured the scene to start the investigation.

Branch Manager Halsey and Inspector Allen Hinkle arrived at SFKK at approximately 7:45 p.m. The two were met by park management who explained what had happened. Branch Manager Halsey issued a Stop Operation Order[4] at approximately 8:00 p.m. for the Superman Tower of Power. This order was given to Jay Thomas, the president of SFKK. The order directed that the ride was to be shut down until the investigation of the incident was complete.

The inspectors immediately observed the broken cable hanging from section III of the ride. While the break was obvious, the cause of the cable failure was not readily apparent.

All witnesses to the incident had exited the park by the time the inspectors had arrived, except SFKK personnel. The inspectors took verbal statements from SFKK personnel as they became available, in addition to gathering all available maintenance and operations data. They also received copies of the witness statements that SFKK had taken from park personnel, individuals on the ride at the time of the incident and bystanders.

[4] KDA Stop Operations Order for Superman Tower of Power, June 21, 2007

The inspectors began their investigation of physical items at 9:00 p.m. when SFKK closed for the evening. The inspectors visually inspected the outside of the ride and made observations of the inside of the tower at the bottom, close to the counterweights. They took pictures of the counterweight end of the broken cable and other photographs (internal and external) and measurements preserving details they thought would be useful. The inspectors then visually inspected the ride and its components, and looked for physical evidence that might shed light on the cause of the incident.

Measurements were taken of where the severed limbs and shoes of the injured minor landed in relation to the tower[5]. The injured girl's right shoe was found fifty-three (53) feet from the base of the tower. The left shoe was found fourteen (14) feet from the base of the tower in the direction of section IV of the ride.

The inspectors stopped their investigation activities at 1:00 a.m.

INVESTIGATION DAY 2

The inspectors resumed their activities at 7:00 a.m. the morning of June 22, 2007. Inspector Wheeler rode to the top of the ride in a work basket and observed a portion of the broken cable while traveling upward and taking photographs. At the top of the ride, Inspector Wheeler visually inspected the equipment and electrical devices and took photographs. Inspector Wheeler then observed as SFKK personnel removed the broken cable and the counterweight that were attached to the catch wagon for section III, lowering the cable to the ground with a rope. Inspector Wheeler then observed the cable being moved to the SFKK maintenance shop on Dakota Street.

Each of the two sections of the broken cable was given an identification tag[6]. The counterweight end and the catch wagon end were given tag numbers 8085 and 8084, respectively. The two cable sections were laid out on the floor of the shop and a visual inspection of the entire length of the cable was performed. The cable had a red rust color appearance and broken wires were present. The inspectors used a micrometer to measure the diameter of the cable[7] at varying lengths measured from the counterweight end. It was determined that the cable was an 11-millimeter wire rope with varying diameter readings, some as small as 10.6mm. The location of the cable break was determined to be one-hundred thirty-five (135) feet from the catch wagon end. The KDA inspectors observed that there had been a change in the appearance of the cable as compared to its appearance two and a half months prior to the date of the incident. Based on the visual condition of the cable the inspectors believed that the cable had significantly deteriorated since Inspector Wheeler had last observed the cable in early April of 2007.

A KDA inspection sheet that accompanied the tags was signed by John Schmidt, head of SFKK Maintenance, on behalf of SFKK. It directed that any movement or testing of the

[5] KDA hand sketch of shoe locations
[6] KDA Continued Inspection Sheet for broken cable, with attached evidence tags
[7] KDA cable diameter measurements

cable was to be done only after notification to the KDA. The cable was placed in the office of John Schmidt.

Additional documents were gathered from SFKK, and Inspectors Hinkle and Bruner obtained the Louisville Metro Emergency Medical Services records for the injured rider. KDA personnel exited the park at 7:00 p.m.

WITNESS STATEMENTS & OBSERVATIONS

KDA inspectors determined it would be important to speak to the riders in section III to obtain a complete account of what those persons experienced. In addition, the inspectors sought a more detailed account from the ride operators, as well as a chance to ask them about timing and emergency stop procedures.

Rider Statements

The KDA contacted seat 2 minor and seat 3 minor. The parents of both persons directed the KDA to an attorney who would be representing all three riders in section III of the ride. The KDA asked to speak to both riders to take their statements. In the presence of counsel, both riders provided statements to the KDA. The rider in seat 2 reviewed the statement given to SFKK after the incident and then provided a more detailed statement[8]. The rider in seat 3 also reviewed the statement given to SFKK and then provided a more detailed statement[9].

The injured girl understandably could not provide a statement. The KDA asked for a written statement when she was able, in any manner that was least burdensome for her to provide. The KDA was provided a copy of her answers to a set of written interrogatories associated with the incident.

Statements of the *Three Minor Passengers [Synopsis – not verbatim]*

- Each passenger car contains 4 seats.
- The injured girl was riding in passenger car # 3.
- The injured girl was riding in seat 4. This seat is on the right as viewed looking toward the passenger car.
- The passenger car contained no rider in seat 1.
- The ride started normally.
- The wire rope made a noise and failed when the car was approximately 35 to 45 feet from the ground.
- The passengers screamed “stop the ride”.
- The ride operator was on the park telephone during the ride’s upward travel.
- The passenger car paused approximately 4 to 5 seconds at the top of the ride. (This is part of the ride’s normal function.)
- The carrier and passenger car disconnected. (Normal function)
- The passenger car began to freefall. (Normal function)

[8] Seat 2 rider KDA and SFKK statements.
[9] Seat 3 rider KDA and SFKK statements.

- The legs of the injured girl were severed during the freefall by the portion of the failed cable that fell to the outside of the tower.
- The ride stopped at its normal resting point.

Operator Statements
Main Ride Operator and Assistant Operator were the two individuals in charge of the Superman Tower of Power ride at the time of the incident. Both operators are under eighteen (18) years of age. Both gave short statements to SFKK shortly after the incident. Both operators witnessed the incident.

The KDA made several attempts to contact the Assistant Ride Operator, including sending a certified letter (which the Assistant Ride Operator signed for) asking her to contact the KDA to provide a statement. To this date she has not done so. The KDA used testimony of the Assistant Ride Operator, taken in a deposition associated with the incident, to verify her statements to SFKK.

The KDA was unable to locate personal contact information for the Main Ride Operator. Shortly after the incident the KDA requested to speak with her. The interview took several months to coordinate; it was conducted on April 13, 2008.

Statement of the *Assistant Operator* to SFKK[10] *[Synopsis – not verbatim]*

- My co-worker let as many people in the gate to fill the seats then we checked all the belts to make sure they were ready. We then we hit the section ready button. Then we went back to the gate to hit the buttons to make the ride go.
- When the ride started going up we heard a cord snap and I screamed out "stop the ride"; but it was too late, it was already coming down.
- I looked and saw the girl's foot right in front of me, so I ran to the front and saw my coworker was on the phone trying to get help.
- We tried to let people off the ride but the thing wouldn't come up and I stood there.
- Ms. Mitchell came and told me to get ice and I stayed with her in her office.

Statement of the *Main Ride Operator* to SFKK[11] *[Synopsis – not verbatim]*

- I was working the Superman ride as the loader.
- There was a girl and her friends who had just rode and asked to ride again. There were plenty of seats so they rode in section III. The girl that would be injured was in the furthest right seat. As the ride was ascending the operators noticed some noises coming from the ride about halfway up.
- As the ride continued up, we scanned to see anything unusual when a cable snapped as the ride approached the top.

[10] SFKK assistant operator statement
[11] SFKK main ride operator statement

- I heard some screams and thought the ride might freefall and decided to hit emergency-stop [E-stop]. Before I reached the button the ride released and injured the girl.
- Upon return, I noticed the girl was seated in the restraint such that the seatbelt was holding her in.

Statement of *Main Ride Operator* to the KDA[12] *[Synopsis – not verbatim]*

- The group of three girls rode the ride once without incident. When that ride cycle had ended, the girls got to ride again because there was no line. I remember the same three seats were used the second trip. The seats were checked and the all clear was given. The ride went up.

- After about two seconds I heard a noise like a rollercoaster chain clack. The ride was about eight feet off the ground. When I looked up the cord came out; the cord was flying about. The noise and the cable coming out happened at the same time.

- I called #3333; the park phone number for emergencies. The person answering the phone asked what was going on.

- I reached my head out and around the operator station while I was explaining the situation to the lady on the phone. I told the lady on the phone that the guests were screaming. I was not sure what the people on the ride were screaming due to the volume of noise in the park.

- The lady on the phone said it was normal for riders to scream. I said the screaming was totally different this time because all the riders were screaming.

- I can't remember what the lady on the telephone was saying. I could see the top of the ride. The other ride operator, at the other panel, told me to hit E-stop.

- I hit E-stop, but the ride came down normally.

- I noticed a shoe had fallen on the blue covering. I saw the injured girl. I noticed she was blinking. The injured girl had shifted down in her seat, and had a leg up in the air. At first I thought the injured girl was dead, because she was so far down in the seat. I walked over to make sure she wasn't dead.

- I was still on the phone. I was screaming. The lady on the phone asked questions and tried to get me to calm down.

- Several people came running through the gate and through the line, and began yelling at me. When I hit the E-stop that caused the harness system to remain closed. People were yelling at me to let them out, but I needed a technician to do that.

[12] KDA main ride operator interview notes

- The other ride operator was screaming, and she left the ride.

- Some woman came up and called the police. The lady on the telephone with me hung up the phone to call for first aid. I then hung up the phone.

- A man named Lou came and got me. Lou took me to Katie; and Rachel took me to the rides office about five to ten minutes after the accident. People talked to me and I gave a statement. The park employees had to find the other ride operator.

When asked by the KDA why she did not hit the E-stop before being prompted to do so, the Main Ride Operator stated that she made a deliberate decision not to hit the E-stop. She said the cable was swinging, and she thought if she hit the E-stop the cable might cut persons on the ride.

Other *Rider & Witness* Statements to SFKK and KDA

SFKK took written statements[13] from a number of witnesses to the incident, including the other riders. SFKK provided copies of these statements immediately following the incident.

KDA inspectors received phone calls from a number of witnesses in the days following the incident. Each witness was contacted and asked to provide a written statement[14]. The statements reinforced the timeline of events for the incident and the position of section III at the time of the cable failure.

***SFKK Technical Service* Statements to SFKK,**

SFKK technical service employees Troy Shortridge[15] and David Lindsey[16] provided written statements to KDA inspectors the evening of June 21, 2007.

- EMTs were responding to the injured girl when the technicians arrived.
- The lap bars were locked in place due to the E-stop having been used.
- The lap bars were released approximately 15 minutes later.
- David Lindsey used a ladder to retrieve the injured girl's foot from the top of the blue shade netting.

DOCUMENTS PROVIDED BY SFKK

Medical Report

SFKK provided an accident report to the KDA stating a person was injured on the ride resulting in bi-lateral foot amputation. The time of the incident was approximately 5:00 pm. This report satisfied the SFKK duty to report the injury accident pursuant to 302 KAR 16:070.

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[13] SFKK statements packet
[14] KDA statements packet
[15] Troy Shortridge statement
[16] David Lindsey statement

Cable Inspection, General Description[17]
SFKK provided the KDA with a document titled "Cable Inspection, General Description" that was from a current ride manual provided by Intamin, the ride manufacturer. The inspectors noted that they had not been provided with this document prior to the accident. The document described the manufacturer's recommendations for cable inspection.

June 21, 2007 Ride Operations Daily Pre-opening Checklist[18]
This form was signed by John Schmidt, head of park maintenance, and Louis Briggs, a park technical services employee. The form did not yield any information useful to the investigation.

2007 Reference Sheets[19]
Reference sheets are completed each day the ride is in operation. The fifty-four (54) sheets collected start on April 6, 2007 (the day after the KDA initially inspected the ride) and continue through June 21, 2007. The forms have a block to initial next to each task performed. Thirty-eight (38) tasks are listed. Thirty-one (31) of these tasks are to be done daily, three are to be done monthly, and four are to be done bi-weekly. The biweekly tasks are: check oil in the gearboxes, check winch drums, check cable units and switches, and visually inspect the drive unit. All daily items are initialed on all daily forms for 2007. The biweekly tasks, including checking the winch drums and the cable units and switches, had been initialed last on April 28, 2007, approximately seven and a half weeks prior to the incident, or fifteen (15) bi-weekly intervals. However, bi-weekly task boxes reflecting the same tasks had been checked as late as June 14, 2007 on the Scheduled Maintenance Occurrence Cards.

2007 Scheduled Maintenance Occurrence Cards[20]
Copies of thirteen (13) cards with various dates and tasks were provided to the KDA. The cards are dated before (before meaning the maintenance was to be performed before the date listed) 5/3/2007, before 5/10, 5/10, before 5/17, 5/17, 5/28, 5/31, 6/4, 6/7, 6/11, 6/14, and 6/18. On some of the cards, initials or checks are not visible in the task boxes of the copies submitted to KDA by SFKK. The last clearly initialed box for checking the winch drums and the cable units and switches was June 14, 2007, and no further action was needed. The date of the last card, 6/21/2007, does not have clear initials or markings. SFKK has stated that the bi-weekly maintenance that was scheduled to be performed on 6/21/2007 was re-scheduled for Friday, 6/22/2007. The manual does not specify the days of the week that maintenance is to be performed. The daily ride maintenance verification and safety checks had been initialed on the Ride Operations Pre-Opening Inspection Checklist.

[17] Cable inspection, general description from SFKK manual
[18] June 21, 2007 Ride Operations Pre-opening Checklist
[19] Superman Tower of Power Daily Reference Sheets 4-6-2007 through 6-21-2007
[20] 2007 Scheduled Maintenance Occurrence Cards

2006 Reference Sheets[21]
The same daily inspection forms were used for the 2006 park season. Of the one-hundred twenty-three (123) forms, only one had initials for biweekly checks mentioned above that were visible on the copies submitted to KDA by SFKK.

2005 Reference Sheets[22]
The same daily inspection forms were used for the 2005 park season. Of the one-hundred twenty-three (123) forms, only two had visible initials for biweekly checks mentioned above that were visible on the copies submitted to KDA by SFKK.

2002-2003 Winter Maintenance Material & Labor Records[23]
These records detail the work activities and the numbers of hours spent on a project. The KDA requested and was provided with documents from this period. The records showed the removal and replacement of older cables with new ones. These new cables were the ones on the ride during the incident. A review of these records did not yield any information useful to the investigation.

2005-2006 and 2006-2007 Annual Maintenance and Maintenance Material & Labor Records[24]
The maintenance material on file with SFKK was different from the maintenance manual on file with the KDA. SFKK had a more recent version that had not been made available to the KDA previously. The more recent version included a schedule and details on conducting a cable inspection.

Main Ride Operator Training Material[25]
The training packets provided to the KDA are dated May 12, 2007. The trainers who signed the documents were Mark Brunner and Barbara McDonough. The operators must complete a minimum number of cycles depending on the complexity of the ride to obtain park certification. The Main Ride Operator of the STP was certified by SFKK to operate three rides. She completed STP training, which was provided by Barbara McDonough, on June 2, 2007. The Main Ride Operator completed a training checklist and watched or operated the STP a minimum of thirty (30) cycles. Her position was listed as certified ride operator. Her hire date was May 12, 2007.

Assistant Ride Operator Training Material[26]
SFKK provided training records for the Assistant Ride Operator similar to those provided for the Main Ride Operator. The training packet is dated June 5, 2007. The trainers who signed the documents were Mark Brunner, Mitchell Chester, and Karl Olson. Operators must complete a minimum number of cycles depending on the complexity of the ride to obtain park certification. The Assistant Ride Operator had been certified by SFKK to

[21] 2006 Hellevator (Superman Tower of Power) Daily Reference Sheets
[22] 2005 Hellevator (Superman Tower of Power) Daily Reference Sheets
[23] 2002-2003 winter maintenance material and labor records
[24] 2005-2006 and 2006-2007 annual maintenance and maintenance material and labor records
[25] Main Ride Operator training material
[26] Assistant Ride Operator training material

operate two rides. The Assistant Ride Operator completed STP training on June 6, 2007, provided by Mitchell Chester. She completed a training checklist and watched or operated the STP a minimum of thirty (30) cycles. Her position was listed as host. Her hire date was June 3, 2007.

Wire Rope Invoice[27]
SFKK provided a two-page invoice dated March 17, 2003 for the purchase of cables that were on the ride at the time of the incident. The invoice provided was for the purchase of four left-hand lay, 11-millimeter-diameter, 90-meter-long ropes.

E-stop Documentation
The KDA requested a printout of the errors recorded by the Superman computer system for the day of the incident. SFKK provided the printout[28]. This data required interpretation; an easy-to-interpret version was created with written notes by the KDA[29].

The E-stop (Emergency Stop Button) was hit at 4:55:14 p.m., according to the printout. The time the E-stop was released was 5:05:19 p.m. The time the E-Stop was hit does vary slightly from witness accounts of the time of the incident. The lap bars/harness system will not release after E-stop has been hit; the E-stop must be released by a technician in the control building next to the ride. The passengers on the ride report not being able to open their harnesses at the end of the ride cycle. This is consistent with the E-stop having been triggered sometime before the end of the cycle. On the STP, it is not uncommon to have various electronic devices displaying different times at the same moment.

As a normal function of the ride, the catch cars start travel to the bottom of the ride to resume the normal cycle moments after the passenger car comes to a stop. The catch cars were at the top of the ride at their release position when the E-stop was triggered. Therefore, the E-stop must have been hit by the Main Ride Operator at some time after the passenger car was released, and before the moment delay from the catch car starting downward travel.

[Although the Main Ride Operator states that she is sure she hit the E-stop before the cars were released from the top of the tower, the E-stop records reflect that the ride started freefall before the E-stop was hit.]

DOCUMENTS PROVIDED BY INTAMIN
STP Wire Rope Specifications
KDA inspectors contacted Mr. Sandor Kernacs, the United States representative of Intamin, the manufacturer of the STP. Mr. Kernacs supplied the KDA with the calculated minimum breaking load for the originally supplied 11mm cables. Kernacs gave the specification of 98 kilonewtons (kn) or 22,000 pounds or 11 tons. Kernacs indicated that the nominal diameter of a new wire rope is 11mm, with the core being embedded in plastic and sealed.

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[27] SFKK wire rope invoice
[28] Superman Tower of Power Error Printout for 6/21/2007
[29] Superman Tower of Power Error Printout for 6/21/2007 explanation

The KDA asked Kernacs for the specifications for the wire rope that was to be used on the ride. Kernacs responded by stating the appropriate cable should have been an 8X19/152 rope. He also included a wire rope specification sheet[30] for the rope Intamin currently supplies for the ride. This rope was manufactured by CASAR, and the cable type was Ritcoplast. The KDA asked Kernacs to explain the change in rope requirement from the 8X25/200 cable specification contained in the SFKK manual to the current requirement. Kernacs replied that the wire rope cables go through technical developments. Kernacs stated the CASAR Ritcoplast cable had been supplied by his company for use on this type of ride since 2000; Intamin had used the 8X25/200 cable prior to 2000.

STP Maintenance Materials
Kernacs also supplied a copy of the most recent chapter of the maintenance manual[31] covering scheduled maintenance of the STP. The chapter provided by Kernacs was the same version as in the manual provided by SFKK.

Cable Replacement Guidelines
The STP maintenance manual is silent as to when the wire ropes are to be replaced. In addition, neither the cable specification sheet nor communications with the STP manufacturer provide a cable replacement schedule. Wire rope cables have no definitive expiration date for use on the STP amusement ride. The cable inspection instructions in the maintenance manual direct the user to engage a qualified specialist to conduct an inspection every three months of operation, at the beginning of each season, or if any flaw is found.

CABLE INSPECTION AND TESTING
The broken cable was tagged by the KDA after the incident. The sister cable to the broken cable was later removed and tagged. Both of these cables, and later both cables from section V, were placed in the maintenance office. The cables were not to be moved without KDA knowledge; SFKK complied.

The week following the accident SFKK wished to take a sample of the sister cable. The KDA permitted this sample to be taken; the KDA received a sample of the sample SFKK took.

The cables were first protected by tarpaulins. The cables were loosely wound and placed on and between the tarpaulin sections.

Litigation between the injured girl and SFKK later commenced. The cable was viewed multiple times by both parties to litigation and other interested parties. The KDA was informed and was present for these viewings. The cable was transferred to a wooden crate constructed by SFKK maintenance personnel.

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[30] Intamin wire rope specification sheet
[31] Intamin-supplied Chapter 8 of the Mechanical Maintenance Manual

The KDA decided a scientific analysis of the cable would be needed to determine the cause of its failure. Although the amusement ride inspectors on the staff of the KDA are trained and the majority hold National Association of Amusement Ride Safety Officials (NARRSO) certification, the inspectors are not engineers. Since the KDA does not possess the required instruments or expertise to provide such a comprehensive analysis, an outside laboratory was sought.

A laboratory was selected by the KDA using the required state bidding process. Before testing could begin, the parties in the lawsuit surrounding the incident asked the Judge in their case to enjoin the KDA from testing the cable so that the parties and others involved would have an opportunity to have input on the testing methods and what laboratory would be used. The KDA informed the Judge in that case that the KDA would be willing to follow the recommendations of the Judge regarding input and possible laboratory selection for the benefit of the parties involved. The KDA had no preference regarding lab selection beyond the requirement that the lab could competently perform the tests.

After several weeks of collaboration by the scientific experts of the parties, the parties created a testing protocol. The protocol satisfied all testing requirements of the KDA. Later the parties agreed to have the majority of testing performed in Louisville, Kentucky at a testing firm named IMR Test Labs, a metallurgical services facility. The tension strength tests were to be performed by the CTL Group, another metallurgical services facility located in Skokie, Illinois. The parties agreed that the testing would produce data only; analysis was to be performed by each interested party.

The KDA took possession of cables 3 left, 3 right, 5 left and 5 right from storage at SFKK and delivered them to IMR in Louisville the morning of January 3, 2008. The cables were safely delivered to IMR. KDA took cable specimens to CTL in Illinois on January 16, 2008. Upon delivering the cables to IMR and CTL, the cables were no longer under the constructive possession of the KDA.

The KDA received a copy of the IMR report[32] the last week of January. The KDA received the CTL results[33] on February 28, 2008.

KDA Expert Analysis

Pending the completion of the testing, the KDA searched for experts to analyze the testing results. This process took several weeks. After a thorough search, the KDA selected Semih Genculu, the vice president of Applied Technical Services Inc., to provide expert analysis.

Mr. Genculu reviewed IMR and CTL reports and thereafter provided a letter to the KDA detailing his analysis of the materials. Mr. Genculu stated the failure of the cable on the STP was due to fatigue. Mr. Genculu stated:

> "The metallurgical testing conducted on the wire ropes indicates that the failure was caused by fatigue. This is a progressive failure mechanism where breaks of

[32] IMR test results
[33] CTL test results

> individual wires (flat fractures) occur over repeated load cycles resulting in reduction of the load carrying capacity of the rope. This condition ultimately leads to complete separation via overload of the remaining intact wires (cup and cone fractures) since they can no longer support the load."

When asked if it would have been possible to detect the deteriorating condition of the cable prior to the incident. Mr. Genculu answered this question with the following paragraph in his letter:

> "The extent of progressive (fatigue) cracking would have made it possible for the park personnel to detect the deteriorating condition of the rope had they been following the inspection instructions given in the maintenance manual."

Mr. Genculu stated that without further information, he could not scientifically determine how far in advance the condition of the cable could have been noticed.

With the receipt of Mr. Genculu's letter[34] and there being no new information available, the investigation into the incident on the Superman Tower of Power at Six Flags Kentucky Kingdom was closed.

CONCLUSION

A number of factors came together on June 21, 2007 to produce severe injuries to a ride patron in an incident at Six Flags Kentucky Kingdom.

The KDA is charged with issuing permits for amusement rides and attractions within the Commonwealth. Kentucky statutes require the KDA to perform safety inspections. The KDA inspectors perform visual inspections of rides looking for obvious safety concerns. Inspectors look more closely at areas of a ride that are known to have experienced problems in the past. The KDA spot checks points of mechanical and maintenance interest. While the KDA role sometimes overlaps with the maintenance of the ride or attraction, the KDA does not perform detailed mechanical inspections of every component of rides and attractions in the Commonwealth.

The KDA conducted a routine safety inspection of the Superman Tower of Power on April 5, 2007. As a part of that safety inspection, a KDA inspector spot checked the wire ropes on the ride. The ride manual in the KDA's possession did not contain testing methods or procedures.

The KDA had not been provided with the current version of the STP manual by either SFKK or Intamin. The KDA was later supplied the manual SFKK was using at the time of the accident. Inspector Wheeler reports that he routinely asks ride operators, at least yearly, for updates to manuals and service bulletins. The manual in use by SFKK during the 2007 season was a more recent version than that in the possession of the KDA.

[34] Expert letter

The KDA was in possession of the manual that came with the ride when it was installed between 1994-95. That manual was superseded by a 1998 manual. The KDA had no knowledge that a manual change or update had occurred. Under the statutory and regulatory provisions applicable before and at the time of the incident, SFKK did not have a legal duty to inform the KDA of a manual update.

The cause of the cable failure has been determined to be fatigue, a progressive failure of the mechanism. The cable on the ride was in a condition that caused the cable to fail under its normal load in operation. It is impossible to scientifically determine how long the cable had been in a condition that could lead to the failure of the cable under its normal load. The cables when new are rated to carry at least six times the load placed upon them during normal ride operation. Maintenance records provided by SFKK indicate the cable units and switches were last checked on June 14, 2007, and "no further action was needed." However, based on expert opinion, the deteriorating condition of the cable would have been detected using the procedures outlined in the newer ride manual.

The KDA has determined that it is impossible to pinpoint a specific reason that led to the condition of the cable that ultimately caused the cable to fail.

Numerous witnesses, riders on the ride at the time of the incident, and the main ride operator all have stated the ride produced a loud noise within a few seconds of starting, and within 40 to 45 feet of the starting ground position. The witnesses described the cable falling out from the top of the ride as the ride ascended. The main operator, witnesses, and the ride patrons in section III have all stated the ride patrons in section III were yelling to stop the ride. The ride operator gave a statement to the KDA indicating that training to operate the ride mandated hitting the emergency stop button in the event of either a loud noise or unusual screaming. Inspectors from the KDA timed the travel of the passenger car starting at 45 feet from the ground (the approximate position of the loud noise) and ending during the approximately two second pause at the top of the tower before the freefall (where depressing the emergency stop function would not have stopped the ride) as being at least 10 seconds.

In the KDA's opinion, the injuries to the ride patrons probably would have been limited to cuts and scrapes had the emergency stop button been pressed, in accordance with training, during the 10-second window of time between the loud noise followed by the cable falling and the freefall of the ride.

The considered opinion of the Kentucky Department of Agriculture is the cable condition and ride operator response were the largest factors contributing to the injuries of the ride patron.

VIOLATION

302 KAR 16:020(5) requires that "All amusement rides and amusement attractions shall be maintained in good electrical and mechanical condition and shall be under the supervision of an operator at all times during the operation of the amusement ride or amusement attraction." The KDA has always required amusement ride manuals provided by the manufacturer to be followed to satisfy this requirement.

Based upon scientific evidence and expert opinion, the cause of the cable failure has been determined to be fatigue, a progressive failure of the mechanism. Also based upon expert opinion, it was determined that the extent of the fatigue would have made it possible for SFKK personnel to detect the deteriorating condition of the cable using the procedures outlined in the more recent ride manual. Therefore, a violation of 302 KAR 16:020(5) occurred due to the cable not being maintained in good mechanical condition.

KRS 247.990 contains the penalties to be assessed for violations of amusement ride laws and regulations. KRS 247.990 (3) (c) provides that "Any owner of an amusement ride or attraction who knowingly violates any provision of KRS 247.234 or 247.236 or any administrative regulation promulgated in accordance with KRS 247.234 or 247.236, and the violation is determined to be the cause of a serious injury or death, shall be fined not more than one thousand dollars ($1,000) or be imprisoned in the county jail for not more than one (1) year, or both."

In accordance with KRS 247.990(3) (c), Six Flags Kentucky Kingdom will be assessed an administrative fine of one thousand dollars ($1,000) for not maintaining the Superman Tower of Power in good mechanical condition, causing a serious injury. The Department of Agriculture has uncovered absolutely no evidence of malfeasance; accordingly, the Department will not pursue criminal sanctions, as provided in the statute.

Kentucky Department of Agriculture
Office of Consumer and Environmental Protection
Division of Regulation and Inspection
Amusement Rides Branch
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