Marc Sherrill
Sky Ride- Tramway # A243
Accident / Evacuation
Date: February 18, 2019

I. Accident Description

On Monday February 18, 2019, at approximately 9:22 PM Nancy Medeiros, Regional Manager (RM Medeiros), and Scott Prather, Senior Engineer, both with Cal/OSHA's Amusement Ride and Tramway Unit were contacted by Steve Norby from SeaWorld. Mr. Norby stated that the Sky Ride tramway was undergoing a rope evacuation and that the haul rope had derailed off the sheaves due to a wind event around 6:30 PM that same day. Upon investigation it was determined the tramway could no longer be operated and that an evacuation would be necessary. The park notified Fire Search and Rescue, and they were on site executing the evacuation. As a result of this information, Associate Safety Engineer for tramways, Marc Sherrill (ASE Sherrill) was contacted by RM Medeiros and assigned to investigate the accident.

II. Tramway Description

The Sky Ride at SeaWorld is a Von Roll detachable open-air gondola cabin tramway installed and opened for operation in 1967. The wire rope design speed is 590 feet per minute with a designed capacity of 1200 people per hour. The gondola has a horizontal length of 1487 feet with a vertical rise of 7 feet. There are 36 four-person cabins available for use with a 10-second interval at 118 feet spacing. The grips were designed and manufactured by Von Roll, which are a spring type. There are 2 line towers which span over the bay. The drive side is located on SeaWorld's park side and the tension side is located across the bay adjacent to the harbor parking lot. The tension system is comprised of a concrete counterweight weighing 52,910 lbs. The haul rope was manufactured by Fatzer, was installed in 2016 and is a 30 mm 6X19 wire rope with a safety factor of 4.72:1.

III. Accident Investigation

On February 19, 2019 at 10:30 AM, ASE Sherrill, arrived at SeaWorld to start his investigation. Chris Yuill, Supervisor with Rides Maintenance at Sea World, met ASE Sherrill at the gate and then escorted him to tower #2 of the tramway where ASE Sherrill climbed tower #2. Kenneth Erstad, Daniel Pura, and Carson Best, all three ride maintenance personnel at SeaWorld, had just finished securing the derailed cabin to the sheave assembly and haul rope. Upon inspection, ASE Sherrill could see that the communication line that spans the entire length of the tramway, from the drive station over the two towers to the tension station, became entangled with the grip body and grip rollers of cabin #4 prior to reaching tower #2.

Note: The communication line is a cable of communication wires wrapped in a thick rubber coating supported by a wire "messenger" cable, which is used to attach the communication cable to the structures. The series of wires in the cable are used to connect the tower safety

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circuits and the two stations of the tramway together into the programmable logic controller (PLC).

The park employees reported to ASE Sherrill that at the time the derailment occurred there was a large wind event. This would explain what caused the communication cable to connect with the grip body of cabin #4. As cabin #4 was approaching tower #2 traveling from the direction of the drive station to the tension station the wind most likely crossed the tramway line and blew the communication line over into cabin #4's grip snagging and pulling the grip to the inside of the sheave assembly forcing the haul rope off the sheaves. The grip and assembly design will not allow the grip to pass the tower with a derailment to the inside of the assembly. As a result, this forced the haul rope to be plucked from the grip's jaws leaving the grip and cabin sitting on top of the sheave assembly entangled with the communication line. ASE Sherrill took pictures and completed his physical inspection at tower #2.

That same day, ASE Sherrill met with Buddy Burton, Corporate Senior Director of Safety Risk Management, Darlene Walters, Senior Leader of Plant Engineering, Michael Beatty, Plant Engineering Leader, and Red Bloomer, Doppelmayr Consultant. During the meeting, there was a discussion as to what caused the derailment to take place. As this document will explain, it was determined that there was a wind event, which caused the communication line to become entangled with the grip of cabin #4 causing it to derail at tower #2. The communication lines are tensioned between the stations and towers and during the process of installing the lines there is still sag in the middle of the spans due to the weight of the communication line. When high winds occur these lines can sway up to 6 to 8 feet or more depending on the sag in the line.

Further discussion centered on the following items:

1. Lowering cabin #4 off the tower and placing the haul rope back onto the sheave assembly.
2. The sheave assembly at initial inspection had no obvious signs of damage.
3. Once cabin #4 is removed and the rope is back on the sheaves a more detailed inspection would be performed.
4. Then the rest of the gondola cabins can be unloaded.
5. The haul rope will need to have an Magnetic Rope Test (MRT) by a wire rope expert.
6. Cabin #4's grip and hanger will be disassembled, have nondestructive testing (NDT) performed, and the cabin will be visually inspected for any damage.
7. The communication line will be inspected and either repaired or replaced and relocated to the center of the tower.

Once the meeting was over, ASE Sherrill joined Red Bloomer back on tower #2 as he conducted his own investigation into what happened. Mr. Bloomer quickly came to the same conclusion as

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ASE Sherrill as to the cause of the derailment. The wind blew the communication cable into cabin #4's grip forcing the derailment at tower #2.

ASE Sherrill interviewed the two maintenance personnel, Chad Rankin 3 ½ years at SeaWorld and Oscar Reyes 7 ½ years at SeaWorld. Both mechanics said there were no prior calls from the operators that day or that evening until the high wind shut down occurred around 6 p.m. They stated at the time they got the call they were in the office and heard the winds suddenly pick up and rattle the door. They did not know the wind speeds, but thought they could have been somewhere around 45 mph and lasting up to 20 minutes. They stated at the same time the tramway went down, the Sky Tower went down which they were able to reset and get running again. When they arrived at the tramway, the display indicated there was a high wind shut down, a switch fault at tower #2 indicating a tower derailment, and a proximity switch fault, which is an additional tower safety switch. This tramway has two types of tower safety circuits. One is the frey switch, which is a physical switch that gets broken when the haul rope comes off the sheaves and opens the circuit to stop the tramway. The other is the proximity switch, which is located under the haul rope and detects the metal rope, so when the haul rope moves too far away from the switches sensing range a stop is initiated. The protocol for when a tower fault occurs is to get visual confirmation that there are no issues on the tower. Both maintenance personnel went out to tower #2 and climbed the tower where they noticed the derailment and called their supervisors, Paul Hix and Chris Yuill. The evacuation process started at this time. They stated there were two guests in the derailed cabin and there was a cabin on the other side of the tower with four guests. There were seven cabins total on the haul rope for a total of 16 guests stranded. One cabin was evacuated with a ladder since it was located just outside the drive station. Two cabins were mid-span between towers #1 and #2, and the other two cabins were approximately 15 to 20 feet from tower #1 towards tower #2. This concluded ASE Sherrill's investigation for Tuesday February 19, 2019.

On February 20, 2019 at 7 AM, ASE Sherrill arrived back at SeaWorld to start a report, collect documents, and finish interviewing employees. ASE Sherrill reviewed SeaWorld's Evacuation Procedure and Wind Policy for the Sky Ride. The wind procedure states all the wind speeds and direction settings. These mile-per-hour settings are within reasonable operating parameters, which cause wind alarms when triggered. These wind alarms are audible warnings, when the first warning occurs; the operators start a controlled shut down of the Sky Ride. This includes unloading all the cabins from the haul rope and unloading all the guests off the Sky Ride. The Sky Ride is then shut down for at least 20 minutes after the last alarm is initiated. The wind shut downs are initiated when winds exceed 5 mph over the alarm settings and maintenance is notified. The day leading up to the derailment, the Sky Ride did not receive any audible warnings and was not closed at any time for wind.

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Wind Settings are as follows:

- 20 MPH – North
- 22 MPH – North/Northeast
- 24 MPH – Northeast
- 25 MPH – East/Northeast
- 26 MPH – East
- 25 MPH – East/Southeast
- 24 MPH – Southeast
- 22 MPH – South/Southeast
- 20 MPH – South
- 22 MPH – South/Southwest
- 24 MPH – Southwest
- 25 MPH – West/Southwest
- 26 MPH – West
- 25 MPH – West/Northwest
- 24 MPH – Northwest
- 22 MPH – North/Northwest

These settings are all the audible alarms and the shutdowns occur 5 MPH higher than listed.

ASE Sherrill interviewed Irene Agliam, Assistant Supervisor of Operations with 3 ½ years' experience at Sea World and 2 years on the Sky Ride. She stated there were no issues with wind that day leading up to the high winds. When the tramway shut down she went to the touch screen and noticed the high wind alarm fault. She says the winds seemed to be out of the Northeast around 25-30 mph. The shutdown for winds in this direction is 29 mph. She called the operations supervisor and maintenance for assistance.

ASE Sherrill interviewed David Trujillo, Ride Supervisor since 2014 at SeaWorld. Mr. Trujillo has been an employee for 16 years at SeaWorld. He stated it was nice until the incident, with 5-10 mph winds all day. He was not at the Sky Ride when the high winds came in but he was called when the tramway went down and headed in that direction. He was by the Sky Tower and as he was heading to the Sky Ride, he noticed the palm trees swaying back and forth. He estimated the winds to be around 30 mph and lasting 5 to 10 minutes. He stated the call came in around 6 to 6:15 PM. When he arrived, he noticed a high wind alarm and waited for maintenance to assist. When maintenance arrived, they went to check the tower. He stated the operators were notifying the guests through the PA system every 3 to 5 minutes until the Fire Department was in place to start the evacuation.

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ASE Sherrill interviewed David Thompson, an operator for 1 year and 3 months at SeaWorld. He was trained 3 months ago to work the Sky Ride. David was at the tension station when the tramway stopped. He stated that the day was calm leading up to the accident. He estimated the winds to be between 30 to 40 mph during the wind event and lasted 20 minutes. He stated that it was around 6:15 PM when the tramway stopped and that right before the winds came across the tramway line he could hear the wind pick up. Immediately after that is when the tramway came to a stop.

ASE Sherrill interviewed Mia Ramos, an operator for 2 years at SeaWorld. She was trained 6 months ago to operate the Sky Ride. She stated the winds to be 5 to 10 mph leading up to the accident. She said the tramway stopped around 6:15 PM. She estimated the winds to be at least 25 mph and lasting 20 minutes. She was at the tension station when the tramway stopped. She stated that there were 2 cabins at the tension station with three guests in one cabin and two guests in the other cabin. The cabin with two guests told her their father was in the cabin behind them. She stated she was informed to use the PA system to communicate to the guests that help was on the way. She stated that after it was determined the tramway would be evacuated security was sent to pick up the guests at the tension station.

ASE Sherrill interviewed Jonathan Martinez, an operator for 5 months with SeaWorld and has only been trained to operate the Sky Ride. His position at the time of the accident was at the tension station in the watch position. This position is to watch for sail boats that would be coming in to the shallow water near the tramway and informing them with a bullhorn to stay clear of the area. He stated there was a slight breeze that day. He stated that just prior to the accident he could hear the wind coming, sounding like a plane taking off and all of a sudden it came across the tramway line and the Sky Ride stopped. He said the wind was 37 mph and lasted for 10 minutes.

ASE Sherrill interviewed Hector Ramos, an operator for 1 year and 3 months with SeaWorld and has only been trained to operate the Sky Ride. Hector stated that he was at the drive side when the tramway came to a stop. He stated the wind alarm and shut down occurred simultaneously. He stated this happened around 6 PM. He thought the winds were in the mid 30 mph range and lasted about 20 to 30 minutes. He said there were a few people waiting to get on the ride when it stopped.

ASE Sherrill interviewed Danny Terrazas, an operator for 3 months with SeaWorld and has only been trained to operate the Sky Ride. Danny was on break when the tramway stopped. He was at the drive side in the back room. He said he was operating on the tension side and had just rode across from that side to the drive side prior to his break. He heard the wind alarm go off

and the tramway stop. He stated he went out to see what was happening a few minutes later. He stated the winds were around 14 mph all evening leading up to the stop.

ASE Sherrill interviewed Jacob Cornwell, an operator for 8 months with SeaWorld and has only been trained to operate the Sky Ride. Jacob was operating at the drive on the unload side. He stated the winds were calm all day. He stated the tramway shut down due to a high gust of wind.

That concluded the interviews of the operating staff for the Sky Ride working the day of the accident.

ASE Sherrill met with Steve Norby, Manager for Environmental Health and Safety, to get the names of the guests who were evacuated and the Fire Chief who was the Incident Commander for the evacuation.

ASE Sherrill then completed the on-site investigation.

IV. Evacuation

ASE Sherrill reviewed the evacuation plan in the Standard Operating Procedure Manual for the Sky Ride. SeaWorld's responsibilities for an evacuation are communicating with the guests and providing rollers to the Fire Search and Rescue teams. The rollers are devices used by Search and Rescue teams to ride the haul rope to each cabin. Each cabin has emergency supply bags located under the seats. Each emergency supply bag has glucose tablets, 2 emergency drinking waters, an emergency blanket, and a weighted spool of rope. Fire Search and Rescue is responsible for evacuating each person from the cabins. The evacuation is done with the use of ropes, harnesses, and hardware designed for lowering people to safety. Due to the tramway operating over the bay, guests are lowered into boats, which transport the guests to the docks located nearby. Fire Search and Rescue teams train for an evacuation on the Sky Ride every year. On May 9, 2017, ASE Sherrill, while on inspection, witnessed Fire Search and Rescue training on their evacuation procedures as part of the tramways permit inspection. The training consisted of two cabins loaded with two employees each being evacuated mid span between towers #1 and #2. There was no reason to be concerned with the evacuation process witnessed by ASE Sherrill. Tramway evacuations can be lengthy due to the complicated rigging and rope set-ups involved. Due to SeaWorld's Sky Ride operating over the bay this can add even more time to the evacuation process.

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According to the Incident Detail Report provided by Search and Rescue, at 19:22:26 the phone call came in to report that an evacuation was necessary. Units were assigned at 19:23:56 and 19:24:09 units were en route. The first unit arrived at 19:29:39. At 19:56:02, power to the ride was isolated and rescue operations were started. At 21:18:04, 2 guests were rescued and 2 more were being lowered. By 21:45:33, 7 of the 16 guests stranded in cabins had been evacuated. At 22:22:20, an update that 12 of the 16 guests had been rescued. At 22:48:00, the lowering of the last 2 guests was reported. At 23:17:24, it was confirmed all guests had been rescued and evacuation equipment was being retrieved. The tramway stopped at approximately 18:15, the total time from stop to end of evacuation was 5 hours 2 minutes and 24 seconds.

Timeline:

- 1 hour and 7 minutes to call for an evacuation,
- 34 minutes to start the evacuation,
- 3 hours and 35 minutes to complete the evacuation.

Search and Rescue teams took an average of about 13.5 minutes per person to evacuate. Evacuations can put physical and mental stress on rescue personnel and the rescuee even during training when there is no stress of an actual emergency. With the added stress of the emergency, Fire Search and Rescue personnel performed this evacuation in a safe and timely manner.

ASE Sherrill was able to contact two of the evacuated parties. Due to language barriers with one of the evacuated patrons, ASE Sherrill concluded that it was windy. This was their last ride prior to them leaving the park and heading home for the day.

The other patron explained she was with her daughter, son, and their cousin. When they got on the Sky Ride, the operators split them up with her son and his cousin in one cabin and her and her daughter in the other. She was not happy about being separated. She said when the tramway stopped she was concerned for her son and his cousin. Her cell phone did not have sufficient battery life to be in constant contact with them and the cabins were too far away to communicate. She did not think the emergency blankets were sufficient to keep them warm. Her cabin was evacuated prior to her son's. His cabin was in the middle of the span that was evacuated last. She said her son mentioned hearing someone in the cabin across from them call 911.

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V. Conclusion

The Division has completed the investigation of the accident described in this report. The Division has drawn the following conclusions:

1. The Sky Ride was operating within SeaWorld's standard operating procedures.

2. A gust of wind caused the communication line to become entangled with the grip of cabin #4 causing the derailment.

3. Fire Search and Rescue evacuated the tramway in a safe and timely manner.

VI. Requirements Issued

The Division has issued the following requirements:

1. The grip for cabin #4 shall have nondestructive testing (NDT) performed according to the acceptance criteria established by the manufacturer or qualified engineer. All maintenance requirements prescribed by the manufacturer or qualified engineer shall be followed. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

2. The hanger for cabin #4 shall have NDT performed according to the acceptance criteria established by the manufacturer or qualified engineer. All maintenance requirements of the manufacturer or qualified engineer shall be followed. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

3. Cabin #4 shall be visually inspected in all critical areas of the grip, hanger and cabin. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

4. The grip for cabin #4 shall be "slippage pull tested" and/or field checked according to the criteria established by the manufacturer or qualified engineer. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

5. The haul rope shall be inspected and the inspection shall be documented by a wire rope expert for damage in the area where it contacted the sheave assembly. If the wire rope is damaged then procedures shall be developed to repair or replace the wire rope. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

6. New communication cables shall be installed to replace the damaged cables. Any overhead cables not in use in the safety system shall be removed.

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The overhead cables that are in use shall be limited to 24 volts nominal, except for telephone systems that may exceed the voltage rating, and shall stop the aerial lift should the cable become displaced. All installed overhead communication cables shall be securely mounted to the towers and terminal structures in a position such that they will not contact the haul rope, gondola cabins or grips.

A licensed engineer shall certify the new mounting positions and verify that the communication lines will not contact the haul rope, gondola cabins or grips. After installation of the new communication lines all tower safety circuits and tension station safeties shall be tested for operation and fault annunciation to the PLC. T8CCR 3164 - ANSI B77.1 1982 Section 3.3.3

VII. Documents on File

Sky Ride Preoperational Checklist
Sky Ride Daily Safety Checklist
SeaWorld's Standard Operating Procedure for a Tripped Sky Ride Tower Safety System
SeaWorld's Sky Ride Standard Operating Procedures
Fire Department's Incident Detail Report
Photos taken by the Division