FACTUAL REPORT OF INVESTIGATION
TESLA MODEL X RUN-OFF THE ROADWAY AND COLLISION WITH PRIVATE HOME RESULTING IN POST CRASH FIRE

Lake Forest, CA

HWY17FH013

(23 pages)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.

FACTUAL REPORT OF INVESTIGATION

A. CRASH INFORMATION

Location:	Normandale Drive approaching Countryside Drive, Lake Forest, Orange County, California
Vehicle #1:	2016 Tesla Model X
Operator #1:	Private Operator
Vehicle #2:	1997 BMW parked in private garage of the collision home
Date and Time:	August 25, 2017 at approximately 6:17 p.m.
NTSB #:	**HWY17FH013**

B. INVESTIGATIVE GROUP

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C. CRASH SUMMARY

About 6:17 p.m. pacific daylight time, on Friday, August 25, 2017, a 2016 Tesla Model X electric powered sport utility vehicle occupied by the 55-year-old male driver and a 27-year-old male passenger was traveling east on Normandale Drive in Lake Forest, Orange County, California. The driver lost control of the vehicle, followed by its departure from the roadway to the right (south). The Tesla traversed a sidewalk and landscaped embankment, collided with two small trees, and entered into a drainage ditch. The vehicle followed the path of the ditch, until it collided with a drainage culvert at Countryside Drive. The vehicle then traversed Countryside Drive and impacted a property wall, a residential garage structure and a 1997 BMW sedan parked in the open garage. The crash resulted in a post-crash fire that spread from the Tesla to the BMW, the garage, and the home. The Tesla passenger self-evacuated the vehicle and the driver was assisted from the vehicle by a bystander. The Orange County Fire Authority extinguished the fire, however, following the initial post-crash fire the Tesla had battery thermal events occur after being loaded onto a flatbed tow truck, and when off loaded at a tow yard.

As a result of the crash, the driver sustained serious injuries and the passenger sustained minor injuries. As a result of the battery thermal events, two law enforcement responders, and the tow truck driver sustained minor injuries. The occupants of the home were not injured.

D. DETAILS OF THE INVESTIGATION

The investigation focused on the electric vehicle and fire fighting aspects of the crash, and included the collection of information pertaining to highway factors, vehicle information, human performance, survival factors, and the emergency response as described in the following sections.

1. Highway Factors Information

The crash occurred in a residential neighborhood of Lake Forest, California. The Tesla lost control while driving southeast on Normandale Drive approaching Countryside Drive. Normandale Drive was a city street consisting of two lanes separated by a dashed yellow line, and at the site of the crash was a descending 10 percent downhill grade with a 550-radius curve to the left. There were sidewalks on both sides of Normandale Drive and Countryside Drive. On the southwest side of Normandale Drive and southwest of the sidewalk was a drainage ditch surrounded by bushes and a few trees. Near the intersection of Normandale Drive and Countryside Drive the drainage ditch was routed underneath Countryside Drive through a concrete culvert. Countryside Drive was straight and level street controlled by a stop sign at Normandale Drive. Normandale Drive was a through street at this location with no stop sign. Both Normandale Drive and Countryside Drive were composed of well maintained asphalt. The roadway markings were clearly visible and Normandale Drive had a posted speed limit of 35 miles per hour (mph).

The weather was clear and the roadway dry at the time of the collision. The Tesla departed the roadway to the right (south), traversed a sidewalk and landscaped embankment, collided with 2 small trees and entered a drainage ditch. The vehicle followed the path of the ditch, until it collided with a drainage culvert at Countryside Drive. The vehicle traversed Countryside Drive and impacted a property wall, then the garage structure and a 1993 BMW sedan parked in the open garage. The crash resulted in a post-crash fire that spread from the Tesla to the BMW, and the garage. The vehicles came to rest in the garage and a portion of the home, and immediately after entering the garage a post-crash fire ensued that spread to the residence.

Figure 1 illustrates the location of the crash with the approximate path of the Tesla, impact with two small trees (circled in red), impact with the drainage culvert (indicated by a red X), and impact with the BMW and residence where the Tesla came to rest and location of the post crash fire.

Figure 1: Google Maps Satellite View of Crash Location

Figure 2 provides a view from the top of Normandale Drive approaching Countryside Drive. The left hand curve in which the Tesla departed the roadway is indicated with a red arrow, and the residence is indicated with a red circle. Figure 3 provides a view of the drainage culvert struck by the Tesla (indicated with a red arrow), and the residence (indicated with a red circle).

Figure 2: Normandale Drive Approaching Countryside Drive

Figure 3: Drainage Culvert

The Tesla caught fire and ignited the BMW and the home. Figure 4 provides a view of the Tesla in the garage with visible flames emanating from the lower front portion of the vehicle, with home structure also on fire. Further information regarding the post crash fire is provided in section 5 of this report.

Figure 4: Southbound View of Residence (Source: Orange County Sheriff's Department). Note: photograph timestamp did not reflect the actual date/time.

2. Vehicle Information

There were 2 vehicles involved, a 2016 Tesla Model X occupied by the driver and a passenger, and a 1997 BMW that was unoccupied and parked in the garage at the private home.

2.1. 2016 Tesla Model X

The 2016 Tesla Model X had Vehicle Identification Number (VIN) 5YJXCBE49GFXXXXXX.[1] The Tesla was stored in a paved lot at Southside Towing, 25101 Front St., Lake Forest California, as shown in figure 5. The tow yard was advised to leave as much space around the vehicle as possible as a precaution in case of re-ignition. The vehicle was placed outside on a paved lot with approximately 6 feet of distance to a fence on one side, approximately 15 feet from other vehicles on another side, and then at least 40 feet from objects on two other sides.

Figure 5: Tesla storage position at Southside Towing (Source: Southside Towing)

[1] The last 6 digits of the VIN were replaced with X.

A basic description of the vehicle damage is provided here, and more detailed information and a complete inspection of the high voltage battery is provided in the Vehicle and Battery Group Factual Report, available in the crash docket. The hood, front, and both front fenders were displaced during the crash sequence and did not exhibit fire damage. There was a half circle shaped crushed area just to the right of the center of the hood at the front, as shown in figure 6. It was approximately 9 inches in diameter and contained a red-orange colored residue which was confirmed to be tree bark and sap from the small trees at the scene.

Figure 6: Tesla hood and a portion of the right front fender

The entire front of the vehicle extending to the firewall sustained extensive fire damage. Non-metallic components were burned away or charred. The windshield glass had broken and partially melted, with portions resting on the dashboard and interior. The front wheels, hubs, and brake assemblies were displaced, with the left front components found in the street next to the sidewalk in front of the house and without fire damage. The right front hub with portions of wheel, disk brake assembly, and portions of the steering and suspension components were found resting at the front passenger firewall and dashboard area, as shown in figure 7 and identified by a yellow circle in the figure.

Figure 7: Front of Tesla with portions of right front wheel and other associated components circled in yellow

The driver side of the vehicle sustained fire damage on the upper half, and the lower half had paint that was still intact, but had sustained severe impact damage. The passenger side vehicle body sustained severe fire damage at the level of the door handles and above. Above the door handles and aft of the A-pillar, there was less damage to the exterior with paint visible.

The exterior body panels of the front passenger door were displaced and hanging from the door structure, which remained on the hinges, as shown in figure 8. The driver door was found open and severely deformed with the exterior panel displaced, as shown in figure 9. The right rear passenger door was closed and mostly intact, but with the main glass panel missing. The exterior handle was missing. The left rear door was a partially open. The right rear passenger door had extensive thermal damage at the front extending about the width of the door handle. The right rear exterior door handle was missing. The paint on the rest of the door was intact.

Figure 8: Right front view of Tesla

Figure 9: Left Front View of the Tesla

The back of the car aft of the rear wheels the paint was intact with some soot and charring. The space for the windshield glass extended aft to the point above the front seatbacks. There was fire damage and scorching of the falcon doors. The glass of the rear deck lid was intact. The air foil on the rear deck lid was fire damaged but intact. The front driver and passenger windows were missing the front driver and the small window aft of the passenger door on both sides were intact.

Due to extensive post-crash fire, a limited inspection of the Tesla interior was conducted. The front trunk area, dashboard and windshield were consumed by fire. The front seats were consumed by fire with some residual foam and upholstery remaining. The back seats sustained severe fire damage, but the seat covers and upholstery were charred. The headliner was intact aft of the front seats but sustained fire damage. The dashboard was mostly melted away, with some portions on the far left side intact. The steering wheel was intact but with extensive thermal damage, and the rim was not deformed. The driver foot well was thermally damaged, but the control pedal were intact. The driver seat sustained heavy thermal damage with the cover burned away and portions of interior foam remaining. The driver seat belt webbing was burned away, and the center console had thermal damage and covered in debris

Fire damaged portions of the driver frontal airbag and driver knee bolster airbags were found, but the deployment status was difficult to ascertain from the inspection at the tow yard. Photographs were taken and provided to specialists at Tesla with knowledge of these components. Tesla reviewed the photos provided an evaluation substantiating that the airbags had deployed. The evaluation was marked confidential. The frontal passenger airbag, side curtain airbags and

lateral seat-mounted airbags for the front seats were burned away and deployment status was indeterminate. The side curtain airbags and rear seat lateral seat-mounted airbags were deployed.

The Tesla Event Data Recorder (EDR) report was obtained.[2] The EDR report indicated that the driver and front passenger seat belts were buckled at the time of the crash, and that various seat belt pretensioners, load limiters, and airbags for the driver and passenger had deployed. It also indicated that the high voltage battery disconnect had deployed.

2.2. 1997 BMW 740I

The 1997 BMW that was parked in the garage and struck by the Tesla had VIN WBAGF8328VDLXXXXX. It was struck on the left rear corner and was pushed further into the garage. It sustained impact damage at the rear and left sides. There was additional damage from other debris and extrication from the garage. It also sustained fire damage, which was most severe at the back half. Figure 10 and Figure 11 provide a left and right side view of the BMW, respectively.

Figure 10: Left side view of the BMW

Figure 11: Right side view of the BMW

[2] Attachment: Tesla EDR Report

3. Human Performance Information

3.1. 2016 Tesla Model X Driver

The driver was a 55-year-old male. Information was obtained from the Orange County Sheriff's Department (OCSD).[3] The driver was wearing his seat belt at the time of the crash based on a seatbelt imprint observed on his body by an OCSD officer at the scene while he was being assessed for injury by paramedics. The driver sustained serious injuries based on a description of the driver's injuries as a "broken back" contained in the OCSD Traffic Collision Report. Attempts to locate medical records for the driver were unsuccessful.

At the time of the crash, the driver was unlicensed in the state of California. A police computer records check indicated he previously held a California Class 'C' license that expired in December of 2003. A query of the National Driver Register (NDR) indicated the driver also possessed a Utah driver's license. According to the OCSD investigation, there had been no prior DUI arrests or DUI crashes on record for the driver.

The following summary of the driver's actions are based on NTSB interviews and statements obtained by the OCSD. Further information and complete NTSB interview notes are contained in the Witness Group Chairman's Factual Report, available in the crash docket.

According to interviews, the driver was at his office, located in Lake Forest. After drinking a beer at his office, the driver went to a restaurant in Foothill Ranch and had another beer with lunch. The Tesla driver then picked up the passenger, a day laborer, from the corner of El Toro Road and Jeronimo Road in the city of Lake Forest to work on his personal RV in the afternoon. The driver had agreed to take the passenger home after a couple hours work at the RV's location in Lake Forest. The driver stated that on the return trip after working, as the vehicle drove down Normandale Drive toward El Toro Road, he wanted to show his worker "how fast his Tesla could go". When accelerating, he said he lost control, went off the road, and hit a tree. The driver stated he blacked out and woke up in the garage of the house at Countryside Drive. The Tesla passenger and a bystander pulled the driver out of the smoking Tesla prior to the post-crash fire.

A witness interviewed by OCSD stated that the driver was moving southbound on Normandale Drive and appeared to be traveling at a high rate of speed (estimated in excess of 70 mph) prior to losing control. According to the witness, the vehicle jumped the west curb of Normandale Drive, continued down the sloped embankment, continuing southbound, where the driver hit a tree, then a concrete abutment and finally crossed Countryside Drive, running up the private property of the house on the corner and into an open garage. Witnesses described the driver as dazed and disoriented after the crash and mentioned they could smell alcohol emanating from the driver.

The passenger stated he did not know if the driver was intoxicated and that he did not see the driver consume any alcoholic beverages. While performing their initial investigation, OCSD officers noted that the driver had the odor of an alcoholic beverage coming from his breath and his person, bloodshot watery eyes, and slurred speech. Due to the injuries sustained during the crash, the Tesla driver was transported to Mission Hospital by Orange County Fire Authority (OCFA). An OCSD deputy followed the ambulance and conducted a DUI investigation at the hospital.

[3] Refer to Section 5.1 of this report.

During a postcrash interview, the Tesla driver reported that he had consumed two beers prior to the trip. The driver also stated that he was drunk and drove while he was drunk. A blood test was administered by OCSD officers and the driver was subsequently arrested for DUI Causing Injury. In an interview with an OCSD officer, the driver indicated he had slept from 8 pm to 7 am the night prior to the crash, which would have allowed for 11 hours of sleep.

3.2. Blood Toxicology

A blood sample was taken from the Tesla driver at Mission Hospital at 7:54 p.m. on August 25, 2017 and sent by the OCSD to a lab for testing. The Orange County Crime Lab performed testing on the sample and results were positive for alcohol with a Blood Alcohol Concentration (BAC) of 0.299 ± 0.012. The test results were negative for benzodiazepines, cocaine, metabolites, methamphetamine, opiates, oxycodone, oxymorphone, cannabinoids, zolpidem, and other drugs.[4]

2.3 Cell Phone Use

In an interview with an OCSD officer, the Tesla passenger indicated that the driver's cell phone was in the center console and the phone was not in use at the time of the crash.

4. Survival Factors Information

4.1. Tesla Passenger

The Tesla passenger was a 27-year-old male, seated in the front passenger seat during the collision. He was wearing his seat belt and sustained minor injuries consisting of abrasions to his right arm and refused medical treatment. Figures 12 and 13 show views of the passenger's arm, as photographed by the OCSD on August 26, 2017.

Figure 12: Tesla passenger right arm

Figure 13: Tesla passenger right arm closeup

4.2. Tow Truck Driver

A male tow truck driver sustained minor injuries while operating the flatbed controls located on the side of the tow truck during a vehicle re-ignition event. Refer to section 5 of this report as well as the Vehicle and Battery Group Chairman's Factual Report, available in the crash docket for

[4] Attachment: Driver Toxicology Report.

further information about the re-ignition events. During the response to the re-ignition event, the driver was exposed to smoke and venting gas and combustion materials from the vehicle and suffered burns on his hand and arm. He did not seek medical attention. He allowed an NTSB investigator to photograph his injuries as shown in Figure 14, which was taken on September 6, 2017, 12 days after the event.

Figure 14: Tow truck driver right hand and wrist

The tow truck driver was asked to describe how he sustained the injuries. He noted that he had been wearing gloves, but the fire fighters were spraying a lot of water, and everything was so wet that he could not feel the controls, so had to take his gloves off. The location of the controls on the flatbed are on the sides, just in front of the rear wheels (of the truck), which lined up with the Tesla on the flatbed. He said that it just popped and smoked a bit for about a minute or minute and a half before it caught fire. The sides of the car were releasing smoke, fire, and some sort of material with pressure. He was not sure what the material was, but it was not just smoke, because when the particles hit his hand, they caused burn spots. He said they were uncomfortable and got very itchy during the several days after the event, but he decided he could deal with it and didn't need a doctor. He said that once the car caught fire, the fire fighters applied water from one hose and went to go get a second hose. They told him that they needed the car tipped in a way that they could get under it with the water. He was able to get the flatbed tipped enough to slide the car partially off the truck. He said that the car was attached to a winch on the flat bed. He provided a short cell phone video and noted that it took about 1 to 1.5 hours before they were ready to load the car again.

He was asked to describe the decision to load and transfer the car to the tow yard, after the re-ignition was extinguished, and if he was given any instructions for safety precautions. He said that the fire department asked him to be ready to stop or pull over, and to put it in an isolated area in another event occurred. He said that he kept the chains a bit slack in case he need to remove the car from the flatbed quickly. He said that the option for a police escort was discussed, but they decided not to use one. He said that the transport proceeded without incident, but when he was unloading the Tesla at the tow yard, he heard some pops and it released a bit of smoke, for a period of about 8 to 10 seconds. They had thought about putting the car in a metal shed, but he decided it needed to be in the open and away from other vehicles.

The tow truck driver was asked about the time frame of the events, including the re-ignition on the tow truck and then the 8 to 10 second release of smoke and popping at the tow yard. The discussion attempted to determine how much time passed from when the fire fighters felt that the car was extinguished (from the original fire) until it was loaded on the truck, and then between the time they put it out from the flatbed fire to the time that it exhibited the 8-10 second event at the tow yard. He noted that the best record of timeframes he had was the Southside Towing dispatch logs. He displayed the Southside Towing dispatch log on a computer screen, but did not have a way to print the full log, so a photograph of the screen was taken and is provided in Figure 15.

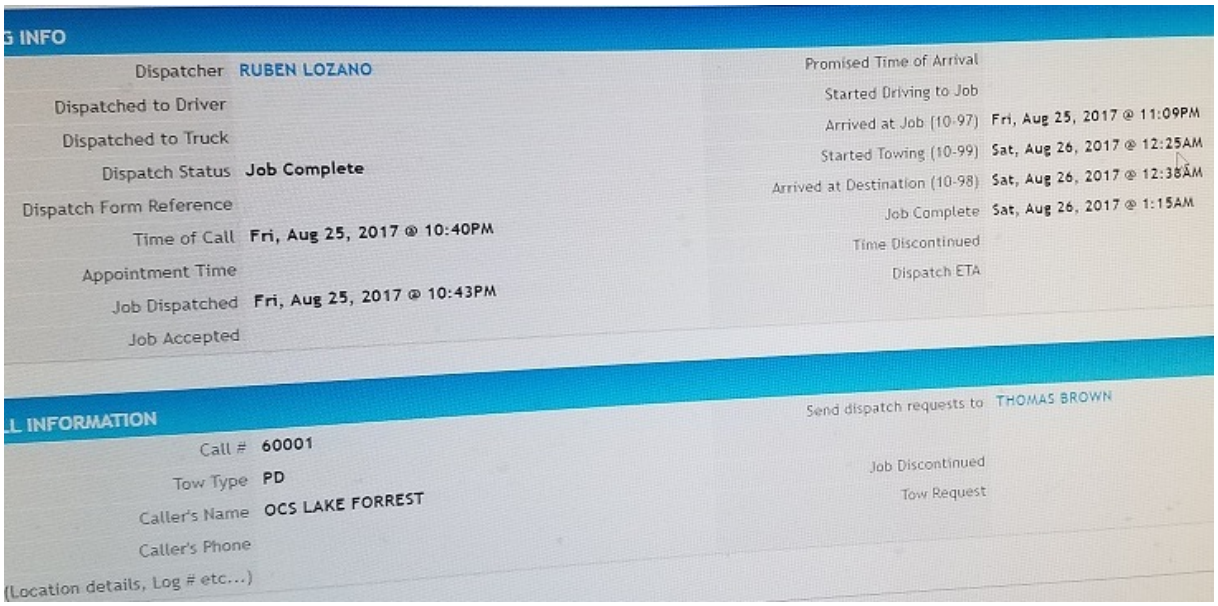

Figure 15: Southside Towing dispatch log for the Tesla towing job.

He noted that the tow yard security cameras should have caught the 8-10 second event, and attempted to access the archived files. However, the DVR system was found to overwrite the files after 10 days. The discussion occurred 12 days after the event, and the video footage no longer existed. The tow truck driver checked if there were any other backup files available, which there were not.

4.3 Responder Injuries

During NTSB investigator discussions with OCSD officers, two officers who had responded to the scene described minor injuries sustained while responding to the crash. One officer described headaches and light-headedness following the on-scene response. He described that the symptoms persisted through the weekend, and that he went into an urgent care facility on the Monday following the response. He was reportedly diagnosed with general smoke inhalation, however blood work results indicated nothing abnormal. He indicated that he filed workers compensation paperwork. The other officer reported headaches and a scratchy throat for a couple days following the event. He did not seek medical treatment. He noted that he filed paperwork under workers compensation to document the exposure. A request for documentation of the injuries was declined. Section 5.3 of this report provides notes from discussions with the OCSD.

5. Emergency Response

5.1. Law Enforcement Information

The Orange County Sheriff's Department (OCSD) had jurisdiction for the crash. The OCSD conducted an investigation, case number 17-033594, and the Traffic Collision Report was obtained.[5] The report provided location and persons involved, scene diagrams and descriptions of the evidence at the scene, narrative reports from law enforcement responders, statements from persons involved, results of vehicle inspection, and opinions and conclusions from the crash.

OCSD was dispatched to an injury traffic collision at Countryside Drive at 6:16 p.m. on 8/25/17. At 6:20 p.m., the call updated that the vehicle was on fire. About 30 seconds later the call updated that the garage was on fire. OCSD officers first arrived on scene at 6:28 p.m. and identified the Tesla driver, Tesla passenger, owners of the house and bystanders. A unified command was established in front of the house and officers worked setting perimeter points and scene management. Officers took witness statements at the scene and sent a unit to Mission Viejo Hospital, where the driver was transported.

An OCSD officer performed a vehicle inspection on the Tesla on August 30, 2017, and a search warrant to obtain hardware containing data from the Tesla Electronic Control Unit (ECU) was obtained on September 6, 2017. The OCSD released the ECU hardware to the NTSB, who extracted data and coordinated assistance from Tesla to interpret the data. Refer to the Vehicle Data Recorder Specialist's Factual report for ECU data, available in the crash docket. Data was also processed by Tesla to create the Event Data Recorder (EDR) report as previously referenced.

5.2. Orange County Fire Authority

The Orange County Fire Authority (OCFA) had primary jurisdiction for the crash and provide fire, rescue and Emergency Medical Services (EMS). The OCFA is dispatched by the Orange County Emergency Command Center (ECC). The ECC serves as a secondary 911 Public Service Answering Point and dispatch center for fire and medical in the county. ECC also serves as the operational area coordinator for fire and rescue mutual aid for all Orange County fire service agencies. The OCFA and ECC are located at 1 Fire Authority Road, Irvine, California 92602.

The Orange County Fire Authority Incident Information Fact Sheet for incident number 2017093071 was obtained.[6] The fire incident was established at 6:17 pm and was reported as a building fire with the origin noted as a vehicle. The building was noted as a single family private residence, in normal use. The OCFA response included a total of 28 total responding apparatus.

The OCFA Official Incident Report was obtained, and was marked not for public release. The following sub-sections summarize pertinent content of the report and have been approved by OCFA for public release.

[5] Attachment: OCSD Traffic Collision Report
[6] Attachment: OCFA Incident Information Fact Sheet

5.2.1. Responding Apparatus

The alarm time was at 6:17 p.m., the first unit arrival time was arrival time was at 6:25 p.m., and the last unit cleared time was 12:43 a.m. The incident detail report (computer aided dispatch log), provided the list of responding units, the number of personnel in each, the response times, and the actions take, as shown in Table 1.

Table 1. OCFA Apparatus Response

Unit	Unit Type	# Of Personnel	Assigned	Enroute	Arrival	Action Taken
E31	Engine	4	8/25/2017 18:17:51	8/25/2017 18:18:43	8/25/2017 18:26:59	Incident Commander/Extinguishment
T45	Truck/Aerial	4	8/25/2017 18:17:51	8/25/2017 18:18:41	8/25/2017 18:29:25	Ventilation/Extinguishment
B7	Chief Officer	1	8/25/2017 18:17:51	8/25/2017 18:19:03	8/25/2017 18:25:29	FIRST ON SCENE - Incident Commander
CAR8131	Sheriff	1	8/25/2017 18:18:49	8/25/2017 18:20:46	8/25/2017 18:28:21	Investigation
E19	Engine	4	8/25/2017 18:22:22	8/25/2017 18:22:47	8/25/2017 18:27:58	Advanced Life Support (ALS)
E38	Engine	4	8/25/2017 18:22:22	8/25/2017 18:24:16	8/25/2017 18:31:02	Extinguishment
T22	Truck/Aerial	4	8/25/2017 18:25:39	8/25/2017 18:26:31	8/25/2017 18:35:09	Ventilate/Extinguishment
E45	Engine	3	8/25/2017 18:25:39	8/25/2017 18:27:48	8/25/2017 18:35:50	Extinguishment/Salvage and Overhaul
B4	Chief Officer	1	8/25/2017 18:25:39	8/25/2017 18:25:45	8/25/2017 18:32:01	Interior Command
SS1	Fire Department	1	8/25/2017 18:25:39	8/25/2017 18:38:33	8/25/2017 19:11:45	Salvage/Vehicle Removal
I6	Investigator	1	8/25/2017 18:25:39	8/25/2017 18:27:45	8/25/2017 18:49:16	Investigation
N1	Fire Captain	1	8/25/2017 18:25:39	8/25/2017 18:25:47	8/25/2017 18:34:25	General Support
SAFE27	Public Safety	1	8/25/2017 18:25:39	8/25/2017 18:29:14	8/25/2017 18:45:00	Scene Securement
HR6	Heavy Rescue	4	8/25/2017 18:33:06	8/25/2017 18:33:52	8/25/2017 19:02:56	Structural Shoring/Vehicle Removal
T9	Truck/Aerial	4	8/25/2017 18:43:29	8/25/2017 18:45:03	8/25/2017 19:04:34	Provide Manpower
T22	Truck/Aerial	4	8/25/2017 18:46:23	8/25/2017 18:46:35	8/25/2017 20:45:18	Ventilate/Extinguishment
E42	Engine	3	8/25/2017 18:50:13	8/25/2017 18:51:02	8/25/2017 18:56:34	Extinguishment
E222	Engine	4	8/25/2017 18:50:13	8/25/2017 18:50:41	8/25/2017 19:00:52	Extinguishment/Salvage and Overhaul
E20	Engine	4	8/25/2017 19:06:55	8/25/2017 19:07:36	8/25/2017 19:13:01	Assist Firefighter Rehab
CAR8127	Sheriff	1	8/25/2017 19:09:25	8/25/2017 19:10:56	8/25/2017 19:19:14	Investigation

5.2.2. Fire/Rescue/EMS initial response

The Emergency Communications Center (ECC) received the first 911 call for the incident at 6:17 p,m, and began coordination of medical support within a minute. The initial notification was of conflicting reports of a structure and possible vehicle fire, and an unconfirmed report of a vehicle fire with 2 people out of the car was received at 6:19 p.m. Notification obtained from a responding OCSD officer indicated a structure and vehicle were on fire at 6:22 p.m.

The response was upgraded to a structure response and Battalion Chief 7 (B7) arrived first on the scene at 6:25 p.m. and assumed Incident Command (IC). Upon arrival, the IC noted a single-story home with fire venting from the north side of a three-car garage, with obvious

structural damage to the area connecting the two-car portion and the one car portion of the garage. Engine 31 (E31) was the first crew to arrive and initiated a fire attack on the vehicles in the garage.

Mutual aid for EMS support was requested at 6:26 p.m. Engine 19 (E19) arrived on the scene at 6:27 p.m. The driver of the Tesla and an involved passenger were located near the scene.

Between 6:33 p.m. and 6:44 p.m. requests for materials to shore up the front of garage were coordinated. While E31 had knocked down the initial fire in the garage, the structural sagging prevented access to the unprotected attic space above the garage. At 6:44 p.m. it was noted that the bulk of the fire had been knocked down, but that it appeared there was a fuel source in the garage and that there was still fire above the garage. The fire grew in the false dormer area and eventually threatened the interior portion of the dwelling. B4, interior command, requested additional companies to assist with stopping the progress of the fire in the structural portion of the garage, which included Heavy Rescue 6 (HR6) , Truck 9 (T9), Engine 42 (E42), and Engine 222 (E222), which were assigned by dispatch between 6:33 p.m. and 6:50 p.m.

At 6:47:00 p.m., B4 was assigned interior Incident Commander and B7 assigned exterior Incident Commander. While E31 provided extinguishment, Truck 45 (T45), assigned to ventilation group, first ensured the fire had not extended into the living portion of the home, and then placed a gas-powered ventilation blower in service at the front door, made access to the roof, and attempted to check for extension of the fire into a false dormer directly above the garage. T45 had limited access to the involved portion and was unable to progress to the alpha side of the dormer, due the sagging header connection where the post between the garages was missing. At 6:48 p.m. the dispatch report noted that entering the garage remained restricted due to structural concerns.

E19 was assigned to care for the driver, while the passenger refused to go to the hospital and declined medical attention. E19 left the scene with the one patient at 6:50:32 p.m. He was transported as a trauma patient to Mission Hospital in Mission Viejo, CA with OCSD officers following up. E19 arrived at Mission Hospital with the patient at 7:12:47 p.m.

It was noted at 6:55 p.m. that the garage fire continued to grow. After the structural fire progress was stopped, the fire under the Tesla continued to re-ignite on and off until cooling measures were temporarily successful. It was reported by HR6 that the Tesla battery pack compromise was the primary source of fire. Figure 16 shows the house with the Tesla in the garage from a photo taken by the OCFA with a time stamp of 6:56 p.m. The fire in the upper portion of the garage appeared to be separate from the vehicle, but flames can still be seen at the bottom front end of the Tesla. Note that the photograph has been cropped from their original form.

Figure 16: Residence and Tesla at approximately 6:56 p.m. (source: OCFA)

Notification of building officials and utility company occurred from 7:03 p.m to 7:10 p.m. HR6 placed two spot shores under the sagging garage headers to stabilize the wall of the garage. B7 responded with All Clear on the garage and residence at 7:17:52 p.m. Once the building was stabilized, focus turned to the removal of the Tesla. Figure 17 shows a view of the garage and Tesla with a winch cable connected to the right rear wheel of the Tesla, and the photograph was taken by the OCFA with a timestamp of 7:26 p.m.

Figure 17: Garage and Tesla at approximately 7:26 p.m. (source: OCFA)

At 8:04 p.m. the Tesla had been removed from the garage with the winch on HR6, and the Tesla battery was noted as still on fire. The structure was still deemed unsafe to enter by the Incident Commander. Figure 18 shows the Tesla as photographed by the OCFA at approximately 8:05 p.m. The vehicle was now on the driveway and has fire emanating from the bottom of the car.

Figure 18: Tesla at approximately 8:05 p.m. (source: OCFA)

The flames were reportedly quickly extinguished, and the Tesla was noted to be stable for approximately 45 minutes before it began to emit heavy white smoke from the floor of the vehicle. The smoke ignited and began burning in what was described as a blow-torch manner, and emitted high pressure flames out of the driver side floor area. It was noted that a 1.75 inch diameter line was initially used to extinguish these flames, but was unsuccessful. Crews then allowed the vehicle to free burn in an effort to eliminate as many ordinary vehicle combustibles as possible. Once they observed that the fire was limited to what appeared to be the battery trays and floor assembly, they used two preconnected 1.75 inch lines at 200 Gallons per Minute (GPM) and eventually a 2.5 inch line simultaneously for more than 45 minutes to cool the lower portion of the Tesla.

When it was extinguished, a skid steer was requested at 9:02 p.m. for use in accessing the underside of the car, however the estimated arrival time for this equipment was 1.5 to 2 hours. Instead, Fire Fighter (FF) propped up the car with cribbing blocks and a floor jack. The skid steer did arrive later and was used to reposition the Tesla as well as the other car that was in the garage during the collision. Figure 19 shows the Tesla being cribbed up in a photograph taken by the OCFA at approximately 9:13 p.m.

Figure 19: Tesla at approximately 9:13 p.m. (source: OCFA)

5.2.3. Post-Structure/Vehicle Fire/Reignition

The Southside Towing dispatch log (shown in section 3.2 of this report) indicated that they received the call to tow the Tesla at 10:40 p.m., and the tow truck arrived at 11:09 p.m. The IC noted that the Tesla began to smoke again, as the vehicle was being loaded onto the tow truck. Figure 120 shows a still image frame of a cell phone video taken by a Southside Towing worker, which shows a view of the Tesla on fire while partially loaded onto the tow truck. This still image shows the vehicle mostly on the flatbed, with the bed near the ground.

Figure 20: Tesla reignited on the flatbed towtruck. (source: OCFA)

As described by the tow truck driver, the Tesla was raised in elevation and the Tesla unloaded further off the flatbed in order to open up space underneath the car for better application of water. Figure 21 shows a still image from a video taken by an OCSD officer of the same event. This image is later in time, and shows the Tesla further off the truck with the flatbed raised.

Figure 21: Tesla reignited on the flatbed tow truck. (source: OCSD)

The incident log noted that the Tesla was being towed from the scene at 12:21 a.m. The Southside Towing log noted that they started towing at 12:25 p.m. and arrived at the tow yard at 12:38 p.m. As noted by the tow truck driver, the Tesla reportedly began to smoke and make popping sounds during unloading at the yard, but did not emit flames and stopped. The Southside Towing log noted that the job was completed at 1:15 a.m.

5.3. Discussions with First Responders

NTSB investigators held discussions with several first responders. The following sections provide notes from these discussions.

5.3.1. OCFA Fire Captain

The Captain provided some details by telephone on Friday September 1, 2017. He indicated that the garage door was open at the time the Tesla drove in, and struck the back of a parked BMW in the garage. The fire involved the garage structure and fire fighters had to secure the structure during the event. He indicated that fire fighters pulled the burning Tesla out of the garage to gain better access to the car to suppress the fire. He said they applied thousands of gallons of water, that it took a few hours, and that they were surprised at the difficulty in suppressing the fire. He noted that if the car was in a remote location, they would have let it burn itself out, but that it was causing a lot of smoke and a concern for the populated neighborhood. He was asked if the source of the fire could be contributed to the Tesla or another ignition source. He stated that it was caused by the tesla, and that the location was under the car. He also confirmed the report of the battery reigniting after the fire was suppressed and the vehicle was on the flatbed tow truck. He was asked to describe this event, but did not know details, as he was called away from the scene before this occurred.

5.3.2. OCFA Battalion Chief 4

The Chief was interviewed by telephone on September 5, 2017. He described his position as the Battalion Chief (BC) for unit 4. He was asked to describe the dispatch process. He said that the OCFA has their own dispatch system that is connected to the OCSD system. An incoming call is initially routed to the OCFA or the OCSD, depending on the type of call. If the other agency needs to respond, then it will get patched over. This call first was routed to the OCSD, then patched over to fire. He was the second BC to arrive on scene, after BC 7. He was then asked to describe the response to the incident. He indicated that BC 7 arrived, and upon seeing that the house was getting involved in the fire, upgraded it to a structure fire. Later it was upgraded to a working fire. BC 7 assumed command as IC, and as the second arriving BC, he was assigned to command the structure/garage interior portion of the fire. He said that the first piece of OCFA equipment to arrive, and responded that it was Engine 31, followed just a few minutes later by BC 7.

He was asked about the status of the driver when he arrived, and BC 4 noted that upon his arrival, the driver was out of the vehicle and being assessed by FF/paramedics. He was asked to describe his account of the event. BC 4 said that his crew worked on the structure fire, and that the car had taken out a garage beam, and the garage door had fallen down. He noted that the car fire was not being suppressed, and did not want to allow FFs into the garage for closer access due to the risk of collapse, so he went into the house to assess the situation and saw that it was developing into an attic fire, and that there was a risk of further garage structure collapse. He called over a

heavy rescue truck to get the car out of the garage and into the driveway, as it kept reigniting and was feeding the house fire. Once they got the car out of the house, they were able to knock down the house fire in about 45 minutes, but the car fire continued for hours. He was asked to describe how they got the car out, and noted that the parked car that was already in the garage had been pushed into a house bedroom by the Tesla. He said that they stabilized the garage header and got a cable around the car, hitched it to the rescue truck and pulled it out.

He described the Tesla fire as very severe and more difficult to extinguish than they expected. He said they applied a lot of water, but the bottom of the car kept reigniting and would not go out. He said that they started reviewing emergency response guides and looking on the internet to reference appropriate action. He said that the vehicle was forcefully venting a lot of smoke and shooting flames from the bottom of the car laterally out the sides. He said that as this was extending over hours, it was difficult to keep crews fresh, and that they used breathing apparatus due to the acrid smoke, and that he felt it was almost like a HAZMAT fire. He noted that they would have liked to just let it burn, but that the amount of smoke was a concern for the occupants of surrounding houses, and felt that if they did that, it could continue burning for up to 24 hours. He noted that there were lots of bystanders, but that they were moved back away from the operation.

The BC was asked how much water they used. He responded that they applied a very large amount of water, thousands upon thousands of gallons, using 3 hoses of 2.5 inch size. He said a fire fighting effort might use a flow rate of 155 gallons per minute (GPM), but they were running 215 GPM for a long time. He was very surprised that the vehicle fire was so difficult to put out, and that the house fire went out as expected, once they got the car out of the garage. He said they were worried about the large amount of water runoff. He also noted that had this vehicle fire been in an area with a lot of vegetation, instead of a paved driveway, it could have caused real issues.

He was asked if there were any reported injuries to responders or bystanders. He said that he was unaware of any bystander injuries, and that he had the fire fighters filling out exposure reports (because their exposure is cumulative). He thought there were about 45 fire fighters on scene. He was asked to describe the meaning of the term a “working fire”, and responded that a full working fire brings on several additional resources above a structural fire, including a fourth engine, a second truck, a second BC, a safety officer, a hazmat unit, and a Public Information Officer (PIO). He was asked about how they conduct medical support and responded that all of the fire fighters are paramedics and certain units have medical supplied. EMS transport is done by private Basic Life Support (BLS) ambulance. In this case, Care Ambulance transported the driver.

5.3.3. OCFA Battalion Chief 7

Battalion Chief 7 (BC7) was asked to describe the fire event. He responded that they got a call for a vehicle and structure fire in a residential area. He noted that these are often minor, but when he was enroute and looked in the direction of the fire he saw a column of smoke and realized it may not be small. Engine 31 was the first on scene and reported it as a “working fire”. He arrived next and confirmed the people that were involved (the driver and the passenger). Another engine arrived and he assigned them to treat the driver and passenger. He saw that one of the support posts for the garage was missing and started planning on how to deal with structural integrity issues. He said the Tesla was at an angle at which you could not see the BMW that was further inside the garage. At this point there was fire under the car, but thought it could be fuel

spilling under the car, and thought the primary source of the fire was fuel in the garage. They knocked down the fire but could not get a good look in the garage due to the structural concerns. It appeared there was some inaccessible source and he was concerned about the false dormer structure above the garage that was another fuel source, and was difficult to access. He put fire fighters on the roof (instructed not to go to close to the compromised structure. They also shored up the sagging garage header. They gained a head on the structure fire and ordered a heavy rescue squad to pull the Tesla out of the garage so that they could get a better angle on the structure fire, and to see into the garage, as they could not be sure if there were other victims in the garage. They were able to put a line on the car to pull it out. The Tesla fire appeared to be extinguished. The BMW had been pushed into the house and luckily it was not on fire or it would have spread into the house. Once they got the Tesla out of the garage, they were able to quickly get the structure fire under control.

They pulled the Tesla onto the driveway and were surprised that the vehicle started venting again and there was clearly some sort of exothermic reaction happening. He decided to let it burn a few minutes in order to see what was happening. He saw the that fire was not diminishing and that there were orange flames and high pressure venting from the bottom of the car. He was concerned for the safety of the crew and for exposure to smoke as it looked unusual. They had a 1.75 inch line on the Tesla at about 150 GPM and talked about just letting it burn itself out, but it was creating too much smoke. They were looking up information on the phone. He considered using a dry chemical (mytlX), but thought that the pressure events would just blow it out and it would have limited cooling ability. They added a second line and put both up to 200 GPM. They then added a 2.5 inch line running at 250 GPM, so at this point they were running at least 600 GPM. He said they rotated fire crews to keep water on the Tesla and used breathing apparatus for protection. They lifted the car with jacks and put cribbing under it to access the underside. Once they did this it was much easier knock down the fire. They put out the fire and the car looked inert and cool. They brought in a skid-steer to remove debris and look for lingering fire. They also used it to put the car on the street and went back to working on the garage. After some time they loaded the car onto the flatbed (would have to check logs for timing), the car reignited and this time they applied about 300 GPM to put it out. They had the operator drop it off of the flatbed in order to gain access under the car.

After putting it out they reloaded it to the truck and let it sit a while. He instructed the tow truck driver to leave it with a 40 ft clear perimeter and warned dispatch that if there were any vehicle fires reported to inform him in case it was this car. He said that it was frustrating because he could not be sure if it was totally out.

He noted that they will do an after action meeting and conduct training on electric vehicles. He was asked if they had previous training and responded that when the Prius came out, they had live demonstrations on where to cut the vehicle and where to disconnect power, but did not have electric vehicle specific fire training. He said that the incident report is available through the Clerk's office.

5.3.4. Southside Towing tow truck driver

The tow truck driver was interviewed in person at Southside Towing on September 6, 2017. Southside Towing driver Bradford was interviewed in person at Southside Towing, Lake Forest, on September 6, 2017. He was asked about his experience with the response. He said

that the tow truck had been dispatched and was on-scene, and that he got called by the driver on scene to provide additional assistance in loading and securing the vehicle. This was needed because the Telsa had lost wheels and suspension components during the crash event. When he arrived, the vehicle was on the flatbed and being winched up into position, and they were gathering parts that had been displaced from the vehicle. He said that the vehicle had been put on some wood planks due to the missing wheels. As they were preparing to secure the vehicle, it stated to make popping sounds and emit smoke, and then re-ignited. The fire fighters brought over a water line and started applying water, but it was not getting under the car due to the wood planks blocking access, so they indicated that the vehicle need to get taken off the truck. He went to the controls and suffered burns to his hand while operating the flatbed tow truck controls to lower the burning Tesla so that the fire could be extinguished. He did not seek professional medical treatment. The driver provided further information in a follow up discussion, which is provided in section 4.2 of this report.

5.3.5. OCSD Officers

A discussion with three OCSD officers that responded to the scene was held at the OCSD office on September 7, 2017.

The first officer was in a marked car and self dispatched to the scene. The vehicle was still on fire when he arrived, and the driver was out of the car. He said that bystanders helped the driver out, and over to a curb a little distance away. The passenger was also sitting on a curb. He spoke to the driver briefly, who he said was “out of it”, and left him with a deputy. He collected a statement from the passenger, who said he didn’t remember much. The passenger said he was picked up earlier in the day and said he worked on the driver’s RV and that he was being taken home. The officer didn’t recall information about the fire suppression. He directed the OCSD investigation and left after the last fire engine left. He was not in the vicinity of the Tesla and Tow truck during that event. He spoke to the neighbor (who lives 3 houses down), who reportedly pulled the driver out of the car. That neighbor described hearing a crash and ran to the house and the fire was already started. The neighbor said the passenger was already out of the car and he helped the driver get out through the passenger door because it was already open.

The second officer said there were about 10 fire trucks on scene when he arrived and that the Tesla was still in the garage. He noted that another officer (the first in this discussion) was assigned as the primary officer, and that he was assigned to take measurements and collect evidence. He said that the FFs were working and he was waiting to hear when it was safe to approach the garage. He said that a photographer was also initially turned away due to safety concerns and returned later. When they returned, the car had been moved into the street. He took measurements with the Tesla on the street and then the tow truck driver arrived. He said the first tow truck driver called into the office for assistance on loading the vehicle. Another tow operator arrived and after they loaded the Tesla and were working to strap it down, it started popping and smoking again. He went to tell the FF and by the time he did, the Tesla was on fire again. The fire was coming out from the bottom passenger side of the car while on the tow truck, so the operator used the driver side controls to lower the vehicle off the truck. He left the scene and later got a headache. He decided to go into urgent care on Monday due to a continuous headache. The officer was asked about his injuries sustained while responding to the crash. He said that he suffered headaches and light-headedness after the response, and since it persisted through the weekend, he went into an urgent care facility on the Monday following the response. He also

noted that he spoke to the Sergeant on the day following the incident to let him know about the symptoms. He was asked about the findings or diagnosis and responded that he had general smoke inhalation. He had blood work done and the results came back with nothing abnormal. He filed workers compensation paperwork.

The third officer was asked about his participation and injuries sustained during the response. He said that he worked setting perimeter points and scene management. He noted that the unified command was set up in front of the house, and that standing the area while the wind was in favorable direction, it was fine, but uncomfortable when downwind from the smoke. He said that for a couple of days following the event, he had headaches and a scratchy throat. He was asked about medical treatment and said that he did not seek professional treatment. He did file paperwork under workers compensation in order to document the exposure. He felt it was important to document these cases where law enforcement officers can be exposed to these conditions. He would like to ensure that officers are aware of the risks and that they should get treated and file paperwork when needed.

E. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

Attachment: Driver Toxicology Report
Attachment: OCSD Traffic Collision Report
Attachment: Tesla EDR Report
Attachment: OCFA Incident Information Fact Sheet

END OF REPORT