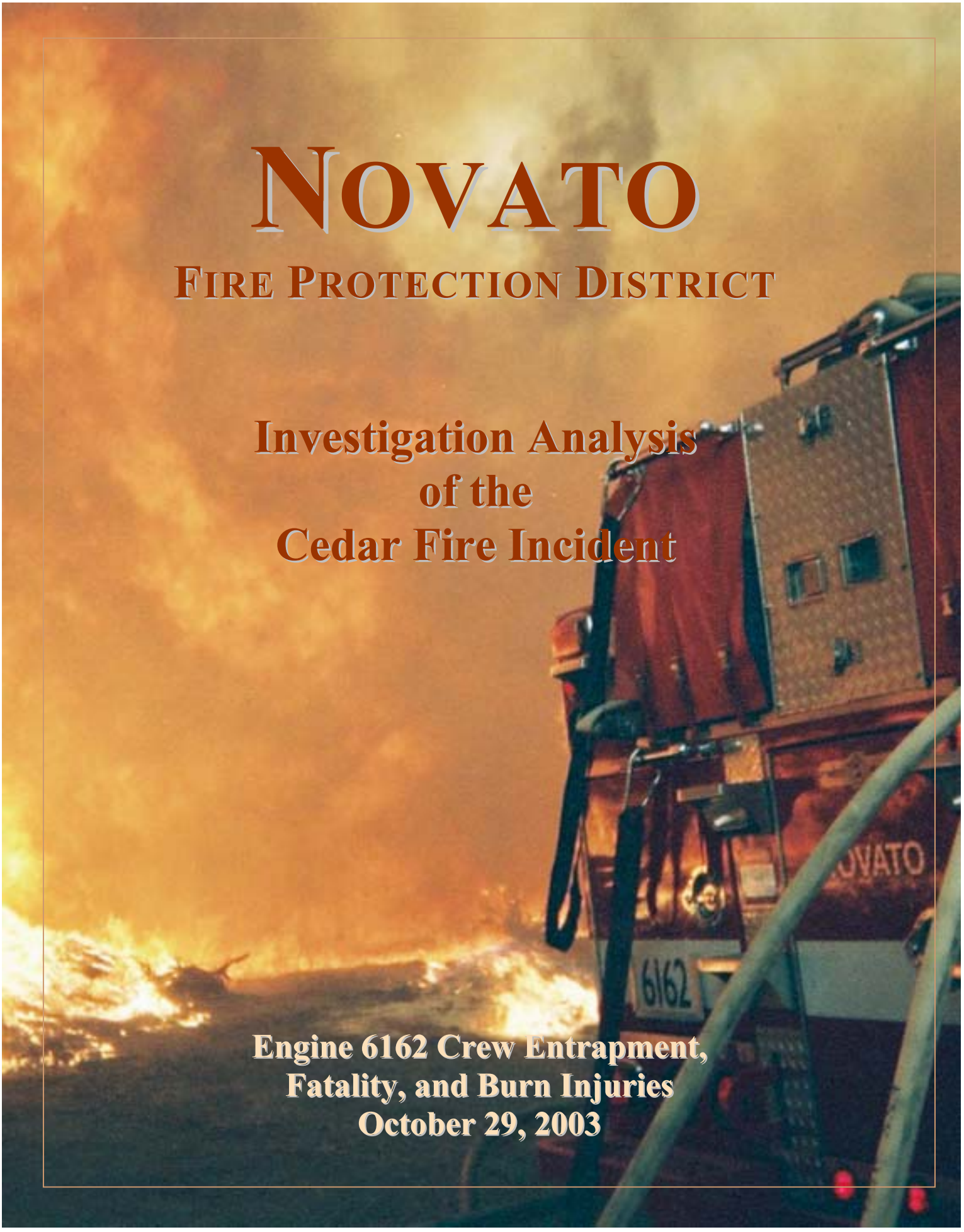


NOVATO

FIRE PROTECTION DISTRICT

Investigation Analysis of the Cedar Fire Incident

Engine 6162 Crew Entrapment, Fatality, and Burn Injuries
October 29, 2003

TABLE OF CONTENTS

In Memory Of
Engineer Steven Rucker
and dedicated to the surviving crewmembers of Engine 6162
and to all firefighters who risk their lives for those they serve.

The Novato Fire District produced this report with hope that the reader will find within it information worthy of consideration in the ongoing effort to improve firefighter safety and survival in the wildland interface environment.

The contents of this report relate solely to the operations of Novato Fire District Engine 6162 from the time of dispatch on October 27, 2003 until the burn over occurred on the Cedar Fire on October 29, 2003. A careful review of the District equipment, training procedures and policies that may have played a role in this event was conducted. The results are included in this report.

The reader is cautioned about forming opinions or coming to conclusions regarding the contributing factors leading to the burn over of Novato Engine 6162 on the Cedar incident, based on this report alone. This report is inconclusive in the sense that only the immediate factors known to the crew of Engine 6162 have been presented and evaluated.

There are clearly other verifiable and documented contributing factors, external to the operations of the crew of Engine 6162 , that played a significant role in the Cedar burn over. Please refer to the California Department of Forestry and Fire Protection Cedar Fire – *Engine Crew Entrapment, Fatality, and Burn Injuries* report when it is published for this information.

Every firefighter deserves a round trip,
and to that end we must constantly remind ourselves
that the life of a firefighter is far more valuable
than any forest or structure they may be asked to protect.

Green Sheet Information

The CDF Green Sheet on the Cedar Fire was published without comments from Novato Fire District Captain Doug McDonald.

California Department of Forestry and Fire Protection

Investigation Summaries of Serious CDF Injuries, Illnesses, Accidents and Near-Miss Incidents

Engine Crew Entrapment Fatality and Burn Injuries

October 29, 2003

Cedar Fire

CACNF-003056
CACSR-000132

Southern Region

A Board of Review has not approved this Summary Report. It is intended as a safety and training tool, an aid to preventing future occurrences, and to inform interested parties. Because it is published on a short time frame, the information contained herein is subject to revision as further investigation is conducted and additional information is developed.

Incident Summary

The Cedar Fire was reported on Saturday, October 25, 2003, at approximately 5:37 P.M. The fire, burning under a Santa Ana wind condition, eventually consumed 280,278 acres and destroyed 2,232 structures, 22 commercial buildings, and 566 outbuildings, damaging another 53 structures and 10 outbuildings. There was one fire fighter fatality, 13 civilian fatalities and 107 injuries. The fire was under Unified Command with the United States Forest Service, the California Department of Forestry and Fire Protection, and local government.

On October 29, 2003 four personnel from Engine Company 6162 (Engine 6162) of the Novato Fire Protection District, as part of Strike Team XAL2005A, were overrun by fire while defending a residential structure located on Orchard Lane in the community of Wynola, in rural San Diego County.

The fire made a wind-driven run through heavy brush directly toward their position, covering a distance of approximately one-half mile in just less than two minutes. One crewmember died at the scene and the three others were provided treatment and then airlifted to the University of San Diego Burn Center.

Conditions

The accident site was located on a ridge near the origin of the San Diego River drainage. Slopes at the accident site range between 12-20%. The elevation at the accident site is approximately 3800 feet, 400 feet above the bottom of the drainage.

The Palmer Drought Index shows a preliminary reading of -2.88. The fuel models in the immediately area of the accident site were Fuel Model 4-brush (with at least 90% crown closure) and Fuel Model 1-grass. Live fuel moisture values were below critical levels.

At the time of the accident a strong onshore pressure gradient had developed with sustained winds of 17 mph and a gust of 31 mph out of the west. At 2:30 P.M. at the accident site the temperature was 70 degrees and the relative humidity was 30%.

As all the fire environment factors of fuel, wind and topography came into alignment there was a sustained run from the southwest directly to the accident site as a running crown fire. Flame lengths were calculated to be in excess of 78 feet, fire line intensities in excess of 73,989 BTU/ft/sec, and rates of spread in excess of 16 miles per hour (for the maximum wind speed recorded at 31 mph). It took the fire a little under 2 minutes to go from the bottom of the slope to the top, a distance of .46 miles. All fuels, both dead and live were totally consumed below the accident site.

Road Conditions: The access to the accident site is a curving ten-foot wide, 490-foot long cement driveway proceeding uphill to the residence. The driveway is overgrown with brush and requires trimming to allow ingress. At the ridge top, the driveway makes a

sharp 90 degree curve to the south that finally orients in line with the ridge along the west side of the house.

Make/Model of Equipment: Engine 6162 is a series 2000 International similar to a CDF Model 14. It is outfitted with a 4-person cab; 500-gallon tank and a 500 gallon-per-minute (GPM) pump. The engine is 8 feet 8 inches wide, 24 feet long, and 9 feet 4 inches tall.

Sequence Of Events

By 11:00 A.M. on October 29, 2003, the Cedar Fire had crossed Highway 78 spreading along the ridge on the west side of the San Diego River drainage. The fire was making short runs (averaging less than 100 yards) in the grass, brush and oak trees. Helicopters were making bucket drops in an effort to keep the fire on the west side of the San Diego River drainage.

The fire on the west side of the drainage moved up canyon and gained elevation. Under the influence of a west wind, higher up in the drainage, the spread to the northeast, burning the property at 902 Orchard Lane. (See Fire Spread Map) Spot fires are observed in the area and both helicopters and ground resources are moved to the area of Orchard Lane. This includes ST2005A, with Engine 6162, which has a four-person crew including a Captain, two Engineers (who will be referred to as Engineer #1 and Engineer #2) and a Fire Fighter.

At about 12:15 P.M., the Strike Team Leader for 2005A, after reviewing conditions, assigns Engine 6162 to the residence at 920 Orchard Lane (the site of the accident). No engines are assigned to 902 or 930 Orchard Lane. (See Orchard Lane Detail Map) A Captain and an Engineer, in a utility vehicle, arrive at 902 Orchard Lane and begin to fire out around the residence.

While the Captain from Engine 6162 walks ahead to evaluate, Engine 6162 backs up the driveway as overhanging brush is cleared by the crew of Engine 6162. (See Accident Site Sketch) The Captain returns to the engine and expresses some concern about the conditions. The Captain and Fire Fighter return to the residence and determine, based on a large cleared area to the southwest side of the property, that the location is defendable.

The cleared area provides for a view to the west and northwest, tall brush and drifting smoke restricts the view to the southwest and no fire activity is visible. They observe smoke from the fire to the north, near 902 Orchard Lane, which is flanking towards them, and determine it to be the greatest threat. Small runs of fire are taking place across the canyon on the west side of the drainage.

The crew observes an up-canyon and up-slope wind, at about 7-10 mph, on a line from where Highway 78 crosses the San Diego River towards the location of 902 Orchard Lane, a natural saddle. The crew develops and implements a plan that includes: brushing and firing below the house; identifying the house and/or engine as a refuge and placing

an axe at the back door; using a residential ladder on the house; laying out 1½" hose lines for engine protection all in an attempt to defend the structure.
The Captain advises the crew of a fire fighter firing out in the area north of the garage. Engineer #1 observes fire on the ground near the garage, and begins strip firing from that location. The Captain throws fusees down the slope into the heavy brush below the area strip burned. This results in a partial burn.

At about 12:25 P.M. the Captain and Engineer, in the utility vehicle, arrive at 930 Orchard Lane. They begin firing around the structures from south to north along the west side of the structures. The Captain instructs the Engineer to take the line of fire to the next house to the north, which is 920 Orchard Lane. The Engineer begins to lay fire towards the north in 15-foot brush with dry grass underneath. Active burning conditions result from this firing and the Engineer does not continue north. Fire from the firing operation makes a run east towards the driveway, where a helicopter bucket drop slows it down.

At about 12: 35 P.M. the Strike Team Leader for 2005A arrives at the location of Engine 6162 and reviews their progress and plans. The sky is clear overhead and the winds are moderate. About five minutes after the Strike Team Leader leaves the scene, the crew of Engine 6162 observes an increase in the fire activity below them.

Near where Highway 78 crosses the San Diego River, the fire begins an up-canyon, up-slope run in heavy brush and oak fuels. Wind driven, the fire makes a continuous run directly at 920 Orchard Lane, covering a distance of about one-half mile in les than two minutes. (See Fire Spread Map)

As the fire intensity below them increases the crew retreats to the passenger side of the engine. The Fire Fighter staffs a 1½" hose line at the front bumper, while Engineer #2 staffs a similar hose line near the rear bumper. Engineer #1 is standing at the rear duals. The Captain is believed to be towards the rear of the engine with the only portable radio.

Members of the crew notice a significant wind increase at this time. A flaming front is observed blowing across the driveway in the direction of the garage. Very active fire is observed below them with flame lengths of 40'-50'. Due to intense heat, the Captain orders the crew to move to the shelter of the residence. (See Accident Site Detail Map)

Bushes along the patio behind the crew are burning. The Fire Fighter drops his line and runs in the direction of the raised patio. Upon leaving the protection of the engine he experiences severe thermal conditions. The Fire Fighter leaps past the burning bushes and onto the patio, followed by Engineer #1 who runs to the steps, stumbles and falls to his knees at the top of the steps, recovers, and continues to retreat behind the rear of the house, following the Fire Fighter. Engineer #2 puts on a hose pack stored in the rear compartment of the engine.

Arriving at the rear door, (approximately 170' from the engine) the Fire Fighter and Engineer #1 use the axe to force entry into the residence. Realizing that no one else is

following them, they decide to return and look for the Captain and Engineer #2. At about this time, a radio call is heard indicating a fire fighter is down. Fire burns the charged hose lines (at the rear of the engine) causing the tank to be pumped dry.

The Fire Fighter and Engineer #1 return to the south end of the house. As they near the southeast corner they observe solid flame blowing sideways across the patio. They then see the Captain stagger around the corner out of the flames. He appears to be dazed.

The Captain tells them that Engineer #2 has fallen and states they need to go back for him, the Captain then turns to go back after the fallen engineer. Engineer #1 and the Fire Fighter determine the patio area is untenable. The three retreat back into the residence. Inside they discuss a plan to search for Engineer #2.

After a moment, they open the front door to check the front of the house. Intense heat surges in and the door is closed. After a few minutes, a second attempt is made to try the front door. Engineer #1 exits to search for the missing Engineer followed by the Fire Fighter who turns back when he is hit by a burst of heat.

Engineer #1 moves towards the front bumper line taking small shallow breaths. Engineer #1 observes the body of Engineer #2 on the patio and continues to the bumper line, advancing it towards the body of the down Engineer. Engineer #1 gets a 10-15 second burst of water before the tank is dry.

An increase in heat forces Engineer #1 to take shelter inside the engine. Engineer #1 considers deploying the extra fire shelters stored in the cab. Concerned that the Fire Fighter and Captain may come searching for him, Engineer #1, taking a single breath runs to the front door and rejoins the other two.

The burning structure forces the three to make their way to the engine. The Fire Fighter disconnects the two protection lines. Engineer #1 drives the engine down the driveway to the east. Heavy dark smoke obscures the view and Engineer #1 feels his way, using the feel of the tires dropping off the edge of the pavement to make corrections. At one location the engine is stopped to avoid running off the driveway. Concern about being overrun again convinces them of the need to continue. The Captain transmits a “fire fighter down” message. The crew continues south on Orchard Lane to a location just short of Highway 78.

The three exit the engine and advise a Hot Shot crew that they have been burned. The Hot Shot crew provides medical assistance prior to the three being flown to a hospital burn unit in San Diego for treatment.

Injuries/Damages

Injuries:

The Fire Fighter had minor inhalation injuries to the respiratory tract and first degree burns on the face (under the goggles), and small patches of first-degree burns on the back between the shoulder blades.

Engineer #1 received second-degree burns on the tip of the nose and a two-inch by three-inch area on the back. First-degree burns were also sustained on all knuckles of both hands and an additional two-inch by three-inch area on the back.

The Captain received second-degree burns affecting approximately 28% of the body including the face, ears, arms, elbows, and legs as well as sustaining a respiratory inhalation injury.

Engineer #2 died while running for the house and received extensive burns over most of the body.

Damage:

Plastic lens covers on all four sides of Engine 6162 melted or showed heat damage. The vinyl hose bed cover for the driver's side pre-connect and both rear hose bed covers melted. There was no obvious heat damage to the paint and the engine was driven away from the accident site.

The wood-frame stucco house at 920 Orchard Lane had a rolled paper and tar roof, and a large wooden deck attached to the north end of the house. The house burned to the ground after the surviving crew members left the scene.

SAFETY ISSUES FOR REVIEW

TEN STANDARD FIRE ORDERS APPLICABLE

#1. Keep informed on fire weather conditions and forecasts.

This needs to be an on-going activity based on all available information. This includes fire weather watches and red flag warnings.

#2. Know what your fire is doing at all times.

This should include the main body of the fire and any fingers and hotspots. If there is any firing taking place in the area, this fire activity needs to be monitored also.

#3. Base all actions on current and expected behavior of the fire.

It is important to consider not only the current and expected behavior, but consideration should be given to the unexpected or possible worst-case scenario.

#5. Post lookouts when there is possible danger.

The presence of a posted, dedicated lookout assigned to the division or area of greatest concern/threat would have allowed for an observation of the fire in the drainage.

#6. Be alert. Keep calm. Think clearly. Act decisively.

Command presence during times of stress is imperative. The leadership demonstrated during this event directly saved lives.

#7. Maintain prompt communication with your forces, your supervisor and adjoining forces.

This needs to be accomplished at all levels within the operation, including the crew level, strike team / Task Force level, the division / branch level and the operational level. If air resources are moved into and out of an area this needs to be communicated.

#9. Maintain control of your forces at all times.

When positioning, or repositioning resources during a fluid fire environment, it is critical to ensure that all resources are accounted for, and to the greatest extent possible, know the location of their adjoining forces and the tactics being employed.

#10. Fight fire aggressively, having provided for safety first.

Aggressive actions generally place fire fighters in close proximity to the fire's edge. Safety mitigations must be part of the immediate plan. In this case safety of the crew was demonstrated by aggressive actions taken at the structure to create a more favorable position, which included a safety zone. When reacting to extreme fire behavior accompanied by a rapidly spreading fire, the safety plan needs to be continually evaluated and updated. It appears that all of the necessary Personal Protective Clothing and Equipment was being worn correctly.

18 WATCH OUT SITUATIONS APPLICABLE

#4. You are in an area where you are unfamiliar with local factors influencing fire behavior.

Out of area / region crews need to be briefed on local conditions and fire behavior prior to going onto the fireline.

#5. You are uniformed on strategy, tactics and hazards.

All tactics being implemented both within and adjacent to the assigned division need to be known and communicated to all. This is especially true of firing operations.

#11. You are in heavy cover with unburned fuel between you and the fire.

The inability to estimate fire spread in heavy fuels is often cited as a causal agent in fire line injuries / deaths and is directly related to Situation #12.

#12. You cannot see main fire and you are not in communication with anyone who can.

The lack of knowledge about exactly where the leading edge of the fire is and what it is doing, places those that cannot acquire that information at considerable risk.

#15. You notice that the wind begins to blow, increase or change direction.

While often noticed, if not noticed and communicated in time, any required change in the pre-determined safety plan may not allow for the plan to be communicated and implemented.

#17. You are away from a burned area where terrain and/or cover makes travel to safety zones difficult and slow.

The ability to reach a safety zone, as opposed to an area of refuge, needs to be carefully scrutinized, allowing for a reasonable time frame under the worst-case situation.

COMMON DENOMINATORS APPLICABLE

When there is an unexpected shift in wind direction or speed.

The unexpected shift in direction and rapid increase in the speed of the wind were a direct contribution to this accident.

Fires run uphill surprisingly fast in chimneys, gullies, and on steep slopes.

This fire responded to an upslope / up-canyon influence as it spotted across the highway and into the upper tributary of a major drainage. The accident site was located on a high ridge and at the top of a significant chimney.

L. C. E. S.

Lookouts

Lookouts dedicated to that role need to be identified and have proper communication ability. The Lookout location, and time they will be in place, needs to be known by all crews assigned to that division / location. The use of aerial reconnaissance and aerial lookouts needs to be used when it is the only viable lookout that can adequately perform the function.

Communications

As prompt radio communication begins to degrade, regardless of the reason, the propensity to rely on face-to-face communication requires that everyone realize the increased time it will take to ensure all who need to know specific information have in fact received it.

Lookouts need to have a clear understanding of desired “trigger points” and to whom and how they will be communicated.

Although not a common occurrence, on this incident the loss of a repeater (destroyed by fire) further complicated radio communications.

Command staff must ensure that any and all significant weather information is broadcast to all levels of the incident organization.

The use of VHF and 800 MHz radio frequencies and the potential for lack of communication on the incident, specifically at the division level must be recognized by all personnel. The assignment of multiple tactical frequencies within a division (air resources, structure group, division tactical channel) must be known, and/or monitored for critical radio traffic.

Escape Routes

Escape routes that are identified at any given moment, need to be constantly evaluated and re-evaluated. The utilization of vehicles / structures as refuge and/or Safety Zones needs to be clearly discussed and assigned accordingly. Creating additional defensible space around structures must be included in the re-evaluation of the number, type and location of escape routes. Escape routes for both vehicular and foot traffic need to remain viable throughout the operation and during the worst-case scenario.

Safety Zones

Safety zones need to be identified and/or established and communicated to all who may have to use them. Their size and location needs to be based on both current and expected

fire behavior. While safety zones may be adequate for what is expected, they need to be applied to the burning conditions present to ensure they are adequate.

The difference between safety zones and refuge areas needs to be clearly understood by all who may use them. The pros and cons of each and the desired sequence of use also need to be communicated.

Safety Zones should allow for the required level of safety from as many angles as possible.

INCIDENTAL ISSUES FOR REVIEW

1. Emphasize the need to establish a dedicated "Lookout" position into the ICS organization.

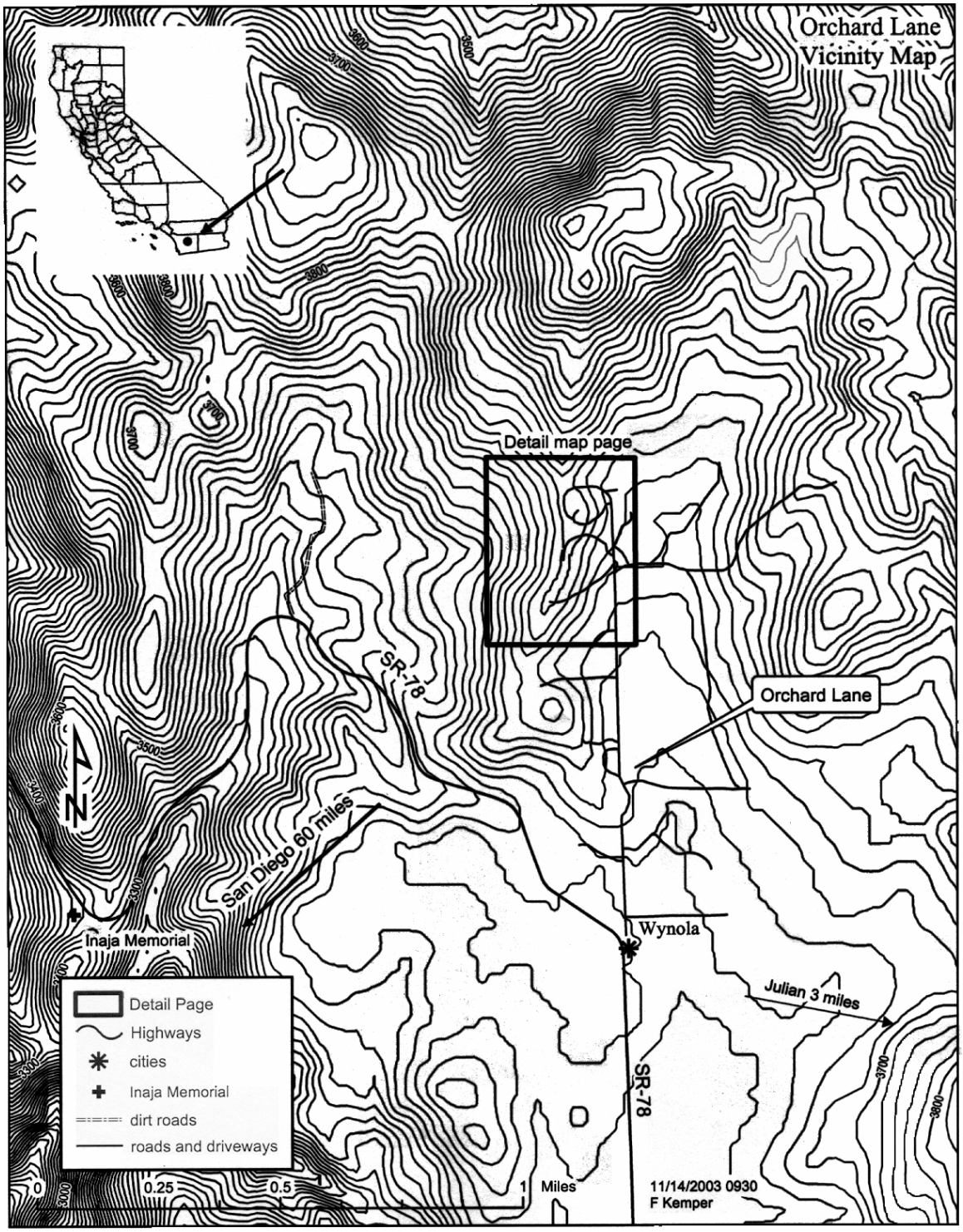
2. Need to review the 10 Standard Orders, 18 Watch Out Situations, and LCES for specific applicability to wildland/interface operations.

3. Need to address interoperability of communication systems within the fire service community. Specifically the 800 MHz versus the VHF frequencies.

4. Need to develop systematic process to inform out-of-area/region resources with local conditions affecting the fire environment.

5. Need to evaluate structure defense philosophies, strategies, and tactics and incorporate into standardized training, technology and procedures.

6. Approximately 1.5 miles southwest of the entrapment site, 11 fire fighters were killed in a fire storm on the Inaja Fire. (See Orchard Lane Vicinity Map) The Inaja Fire started November 25, 1956, under strong Santa Ana winds, the fatalities occurred when the winds turned to the west.


Orchard Lane
Vicinity Map
Detail map page
SR-78
Orchard Lane
San Diego 60 miles
Inaja Memorial
Wynola
Julian 3 miles
SR-78
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Detail Page
Highways
cities
Inaja Memorial
dirt roads
roads and driveways
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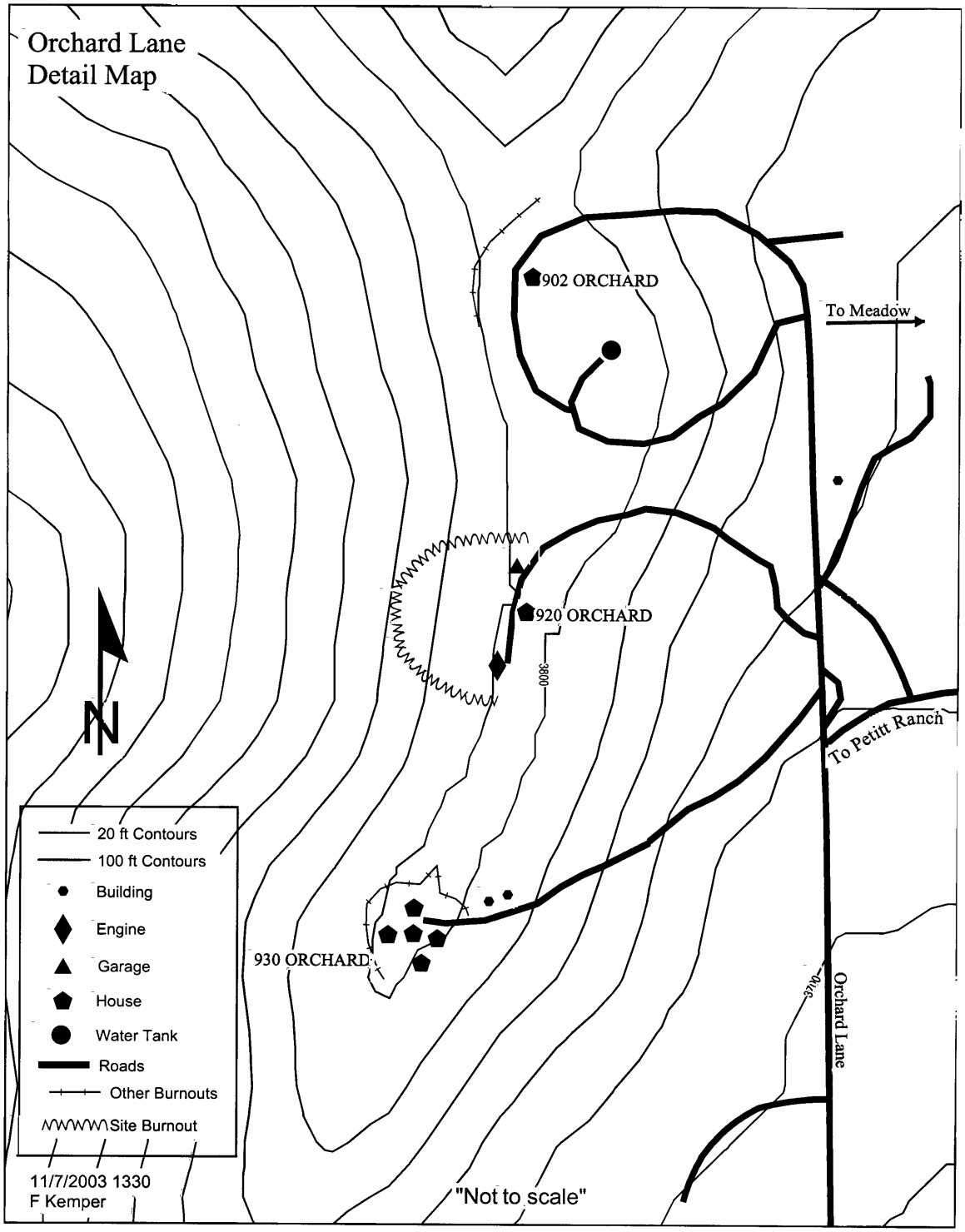
Orchard Lane
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902 ORCHARD
To Meadow
920 ORCHARD
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To Petitt Ranch
930 ORCHARD
3900
Orchard Lane
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20 ft Contours
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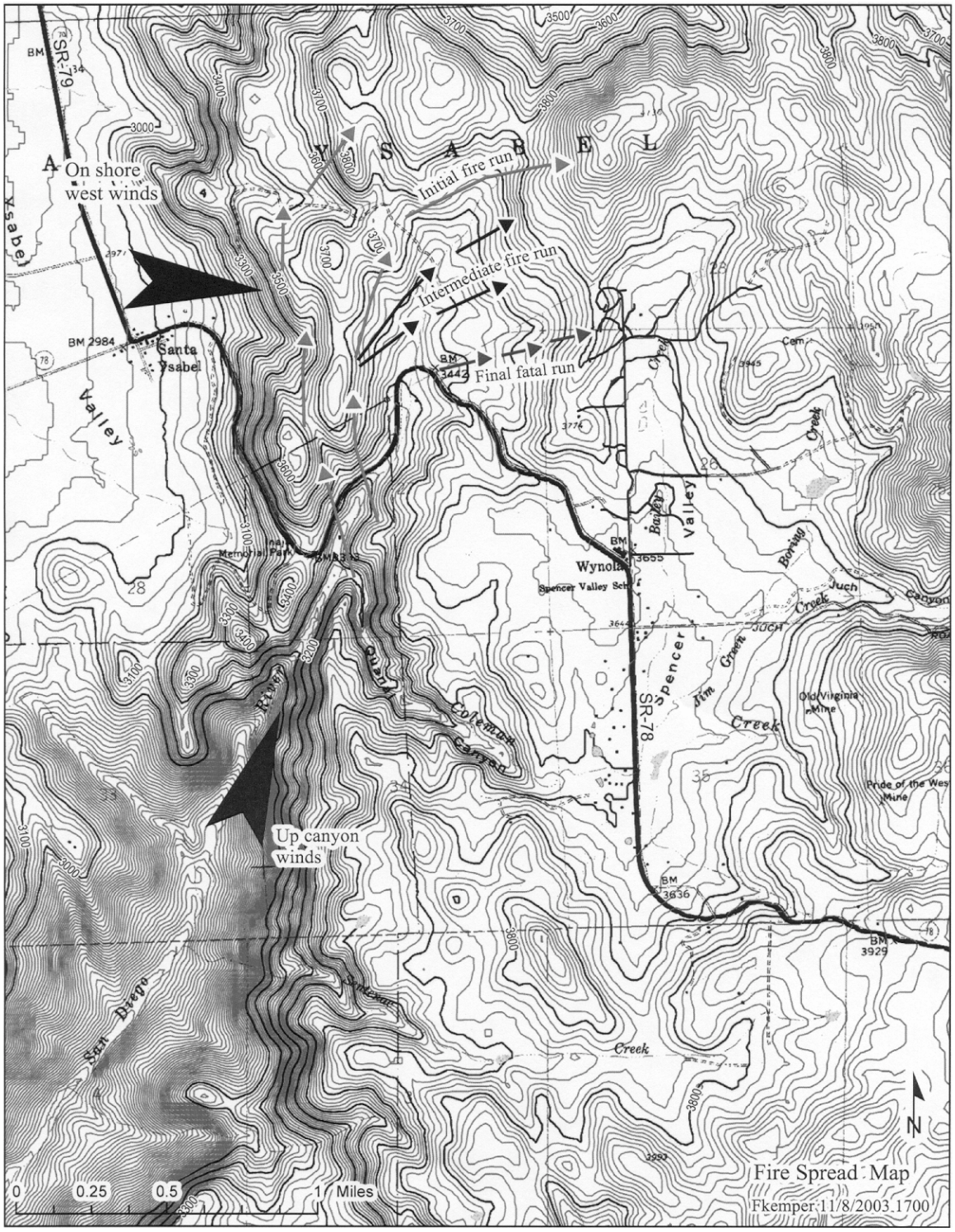
On shore
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Intermediate fire run
Final fatal run
Up canyon
winds
Santa
Ysabel
Wynola
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SR-79
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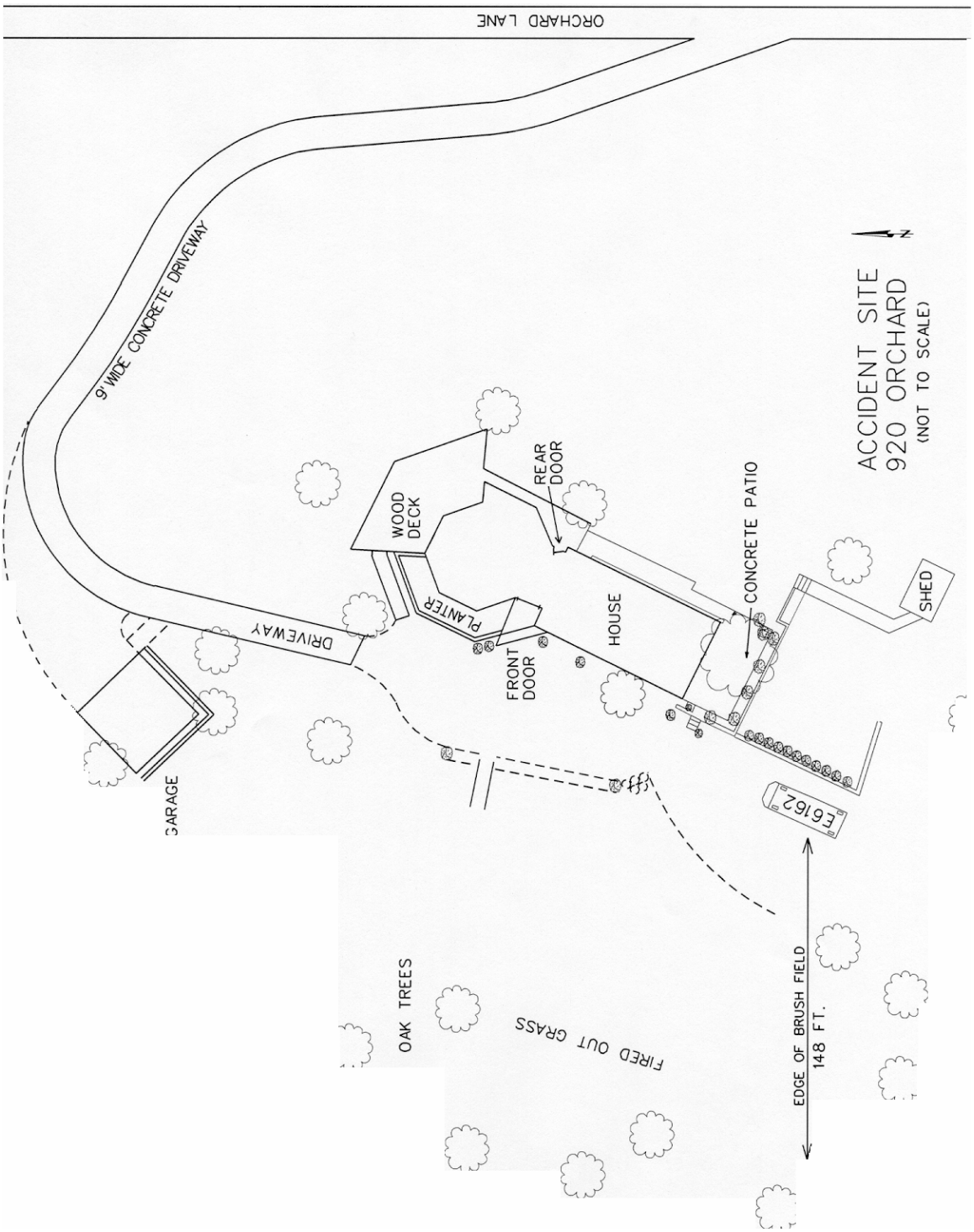
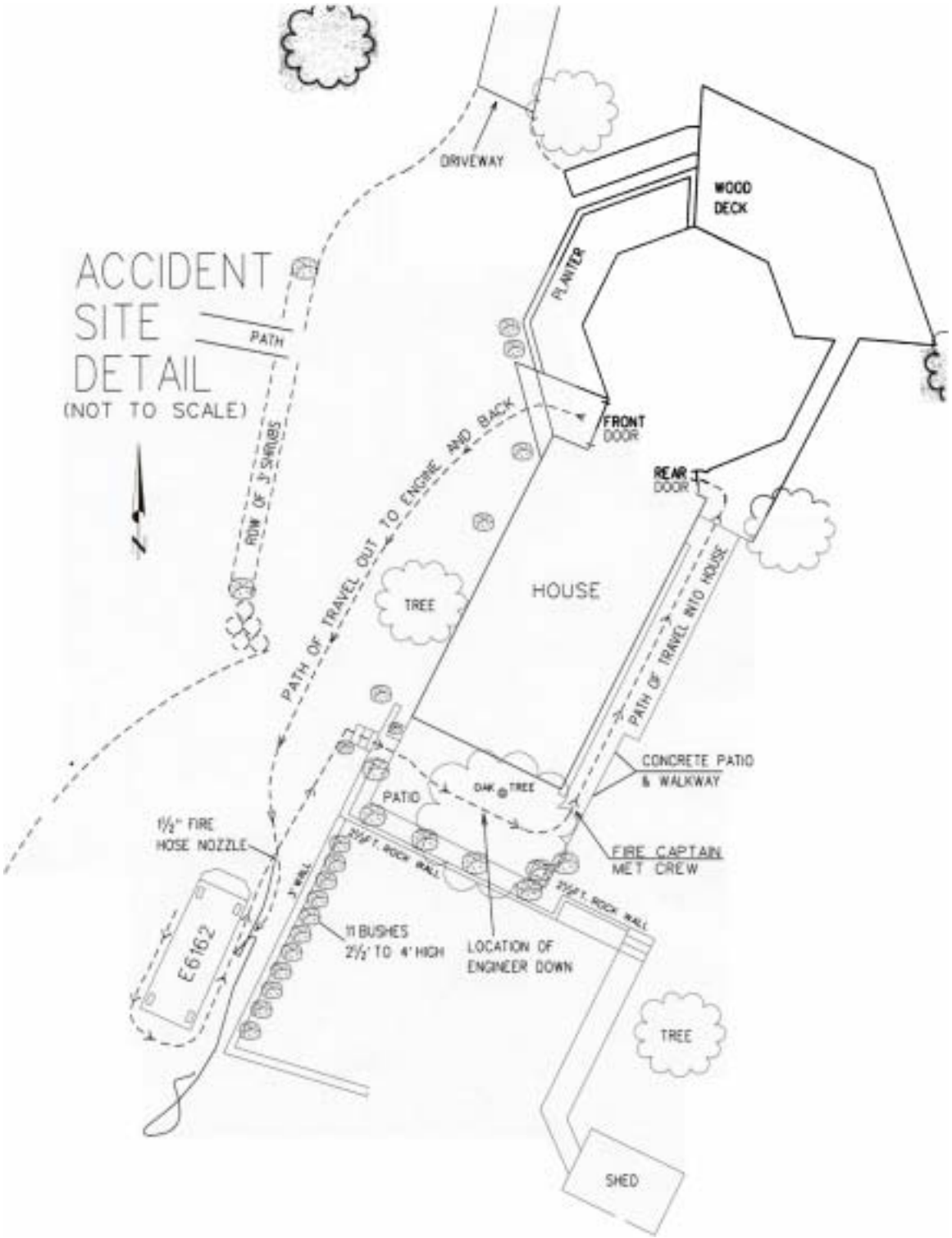

ORCHARD LANE
9' WIDE CONCRETE DRIVEWAY
ACCIDENT SITE
920 ORCHARD
(NOT TO SCALE)
WOOD DECK
REAR DOOR
CONCRETE PATIO
SHED
PLANTER
HOUSE
DRIVEWAY
FRONT DOOR
GARAGE
E6162
OAK TREES
FIRED OUT GRASS
EDGE OF BRUSH FIELD
148 FT.


ACCIDENT SITE DETAIL
(NOT TO SCALE)
PATH
ROW OF SHRUBS
DRIVEWAY
WOOD DECK
PLANTER
FRONT DOOR
REAR DOOR
PATH OF TRAVEL OUT TO ENGINE AND BACK
PATH OF TRAVEL INTO HOUSE
HOUSE
TREE
CONCRETE PATIO & WALKWAY
OAK TREE
PATIO
1½" FIRE HOSE NOZZLE
FIRE CAPTAIN MET CREW
2½ FT. ROCK WALL
11 BUSHES 2½' TO 4' HIGH
LOCATION OF ENGINEER DOWN
E6162
TREE
SHED

Novato Fire Protection District
Overview

Summary

On October 29, 2003 four firefighters from the Novato Fire District were overrun by fire while protecting structures on the Cedar Fire in San Diego County, California. One firefighter was killed; one received first, second, and third degree burns to over 28% of his body and airway inhalation burns. The other two were treated for minor burns and released from the hospital on the morning of October 30, 2003.

The Cedar Fire was under the jurisdiction of the California Department of Forestry and Fire Protection (CDF) the United States Forest Service (USFS). The California Department of Forestry initiated a Accident Review investigation on October 29, 2003. The Novato Fire District assigned two members to the investigative team. Training Battalion Chief Kevin Johnston represented the District as an Agency Representative and Fire Captain Jeff Whittet represented the Novato Professional Firefighters Association.

The CDF investigative team collected information and analyzed data using established wildland fire management guidance. The facts surrounding the accident are included in the CDF Cedar Fire – Engine Crew Entrapment, Fatality and Burn Injuries Report which was not available at the time of the printing of this report.

Novato Fire District Report Procedures

The Novato Fire District assembled a Cedar Recovery Team comprised of District Chief Officers. Several methods were used to obtain critical information relating to the burn over.

- Identifying and collecting information associated directly with the burn over of Engine 6162
- Conducting interviews with NFD members involved in the incident
- Visiting the accident site
- Reviewing the CDF Green sheet and other easily accessible public information relating to the Cedar Fire
- The crew members of Engine 6162 and the NFD members of the CDF Accident Investigation Team were given the opportunity to review and provide input to these documents prior to their release

This report has been compiled specifically for the purposes of detailing the events that occurred directly to the crew of Engine 6162 on the Cedar Fire. The report includes a chronological outline of activities from dispatch through the events of the incident, as

well as an analysis of the use and effectiveness of equipment, PPE, communication, training, ALS equipment, fire behavior, and apparatus.

The Novato Fire District

The Novato Fire District is located in northern Marin County, California. The Fire District encompasses approximately 71 square miles and serves a population of more than 60,000 citizens. It is bordered on the north by San Antonio Creek and Sonoma County, by Pacheco Grade and the community of Marinwood to the south, by the Petaluma River and San Pablo Bay to the east, and west to a point approximately three miles past Stafford Lake. The City of Novato, a general-purpose governmental entity, lies within its boundaries and is served by the District. A large portion of the District lies within a defined wildland urban interface area.

The Operations Division is comprised of the District emergency response personnel and equipment. The daily emergency response staffing for the entire fire district is 20 personnel. This staffing includes one Battalion Chief, four 3-Person Engine Companies, one 3-Person Truck Company and two 2-person Paramedic Ambulances. The District has been assigned and operates OES Engine 235. District personnel cross staff two Type III engines during the wildland season.

The District provides a full range of emergency response services including but not limited to, structural fire suppression, wildland fire suppression, response to hazardous materials incidents, Urban Search and Rescue, water rescue, vehicle extrication, technical rescue as well as basic life support and advanced life support medical services. Fire District emergency response personnel respond to over 4,700 incidents annually, of which approximately 3,000 or 68% are medical in nature, ranging from motor vehicle accidents and elderly falls to childbirths and heart attacks.

All Novato Fire District safety personnel are either Emergency Medical Technicians (EMTs) or Paramedics. EMTs provide Basic Life Support (BLS). EMTs interpret signs and symptoms of injury and disease, and determine the appropriate course of treatment. EMTs are trained to provide Cardio-Pulmonary Resuscitation, administer oxygen, control bleeding, and perform spinal immobilization, splint fractures, as well as any rescue functions needed to free a trapped victim. Paramedics provide Advanced Life Support (ALS). A Paramedic is an advanced level of EMT certification. Paramedics must complete an extensive training program to enable them to perform specialized skills and procedures. These skills include advanced airway management, including intubations, intravenous therapy, pharmacology and drug administration, cardiac monitoring and defibrillation.

All Novato Fire District engine companies have ALS equipment and are staffed with at least one Firefighter/Paramedic, and thus have the ability to immediately administer advanced life support (ALS) pre-hospital emergency medical care upon their arrival. The two District ambulances are staffed with two paramedics each and respond along with an engine company to all medical emergencies.

Cedar Fire

The Cedar Fire was reported on Saturday, October 25, 2003, at approximately 5:37 P.M. The fire, burning under a Santa Ana wind condition eventually consumed 280,278 acres and destroyed 2,232 structures, 22 commercial buildings, and 566 outbuildings, damaging another 53 structures and 10 outbuildings. There was one fire fighter fatality, 13 civilian fatalities and 107 injuries. The fire was under Unified Command with the United States Forest Service, the California Department of Forestry and Fire Protection, and local government (see the CDF *Green Sheet).*

NFD Resource Commitments to Southern California

At the time that the Novato Fire District received a request for a Type III Engine (Engine 6162) to be part of a Task Force dispatched to the Cedar Fire in San Diego County, it had already committed two Type I engines to the Southern California Fire siege.

On October 25, 2003 the Novato Fire District committed Engine 6185, with a crew of three, to the Old Fire as part of Strike Team XMR 2125A, and OES Engine 235, with a crew of four, to the Grand Prix Fire as part of OES ST 2803A.

The Dispatch and Travel of Engine 6162 to the Cedar Fire

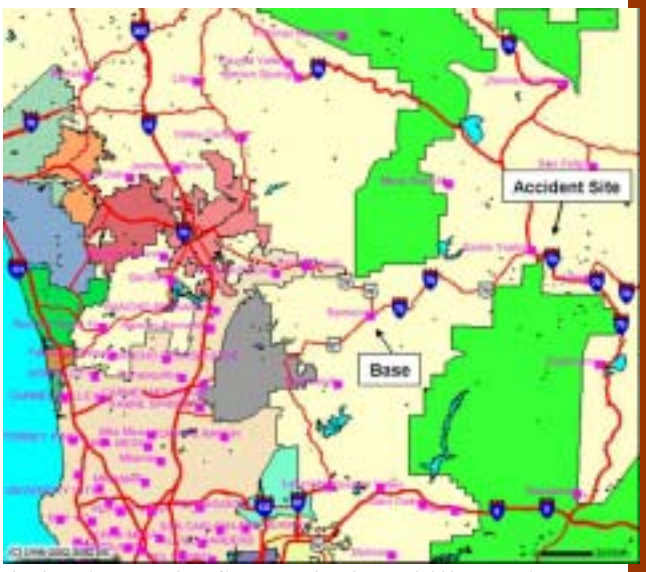
At approximately 7:00 p.m. on the evening of October 27, 2003, the Novato Fire District received a request from the Marin County Fire Department Emergency Communications Center, “Woodacre”, for a Type III engine to respond to San Diego County to assist with the current wildland fires. A four person crew consisting of Captain Doug McDonald, Engineer Shawn Kreps, Engineer Steve Rucker and Firefighter/Paramedic Barrett Smith were assigned, from an established list, to staff Engine 6162 .

The crew had returned to work at 7:30 a. m. that morning, from a four-day break. They had not worked any extra shifts during the preceding few days, nor had anyone had any significant record of illness or injury during the previous weeks. They had a light to moderate call volume that day, and before the actual dispatch at 9:27 p.m., the crew spent time collecting the items they would need for an extended assignment.

Engine 6162 was officially dispatched at 9:27 p.m. by “Woodacre” and traveled from Novato Fire District Station 4, in Novato, to the town of Ramona in San Diego County. They traveled to the truck scales on eastbound Highway 580 in Livermore. At the scales they rendezvoused with the Task Force Leader and Assistant Task Force Leader from Lawrence Livermore Lab and two of the engines, Engine 1541 from Camp Parks and Engine 334 from San Ramon Fire Protection District that would eventually compose the five engine Task Force XAL2005A. The group was designated as a Task Force because it contained a mixture of Type I and Type III engines. All three engines and the Task Force Leader left the scales at 12:00 a.m. A fourth engine, Engine 24 from Vallejo Fire

Department met the convoy in Santa Nella. The Task Force made several pauses for fuel and rest stops along the drive to the Cedar Fire incident base, stopping for fuel at Santa Nella, Interstate 5/Highway 41, and in Pasadena. The crew rotated driving between Engineer Kreps, Engineer Rucker, and FF/PM Smith, approximately every 100 miles. The Task Force arrived at Gillespie Field incident base at 11:00 a.m. on October 28, 2003 after a 13 ½ hour drive. After checking in with the Resource Unit they were directed to Base for food and rest.

Assignments on October 28, 2003



The crew rested for 2 hours and 15 minutes at Gillespie Field. At 1:15 p.m. on October 28, 2003, Task Force 2005A was sent to the area of the intersection of Interstate 8 and Highway 79. They were assigned to a structure protection operation on Riverview Road ("Camp Oliver") where they supported a burnout operation. They were told to hold in the area until 9:30 p.m. and to patrol for hot spots.

During their operations on Riverwood Road, the crew encountered moderate fire behavior as the fire made downhill runs in heavy brush.

The crew returned to the Gillespie Field staging area at 10:00 p.m. for dinner and then bedded down for the night. Engine 6162 members recall going to sleep between 10:30 p.m. and midnight. They arose between 5:00 a.m. and 6:30 a.m. on October 29th. The crews felt rested and were in good spirits. Their Task Force Leader attended the morning briefing at approximately 7:00 a.m. while the crew ate breakfast and completed their typical morning checks on the engine. They ran the pump, completed the pre-trip brake check, and conducted a check for operational readiness.

The Task Force Leader briefed the Task Force on their assignment and shared safety information. There was only one IAP available for the Task Force. A fifth engine, Engine 71, a Federal Engine from Ramona was added to the Task Force.

Engineer Rucker turned in a defective NFD BK radio to Communications and picked up a replacement so that there were two high band portables for four personnel on Engine 6162 . Later, one of Engine 6162's two BK radios was given to the Task Force Leader because he did not have one.

L-R FF/PM Barrett Smith, Engineer Shawn Kreps, Engineer Steve Rucker, and Captain DougMcDonald at Santa Ysabel on morning of Oct. 29, 2003

(Right) Slop over Fire after it crossed Highway 78/79 viewed from Santa Ysabel at 9:47 a.m. on 10/29/03 by crew of Engine 6162 . (B. Smith) (Left) Engine 6162 takes photos as they go through the slop over area. (B. Smith)

At 8:30 a.m., Task Force XAL2005A left the staging area and headed for their Branch III, Division I assignment. They arrived at Santa Ysabel at about 9:15 a.m.

At 9:47 a.m., the Task Force observed, according to Captain McDonald, that the fire had crossed Highway 78/79 between Santa Isabel and the Inaja Memorial. (See photo on right) According to Captain McDonald, he could see engines backing down Highway 78/79 in this area to avoid the fire that had crossed the highway. By about 10:20 a.m. the Task Force was assigned to do structure protection in the Riverwood Estates. Captain McDonald expressed his concern about passing through the area where the fire had recently crossed Highway 78/79; however, the Task Force was able to pass through this area without incident.

The crew of Engine 6162 noted that when they arrived in the Riverwood Estates, a firing operation had already been conducted around the structures and they conducted mop up operations. They watched as the fire burned past them to the west in the distance, the area northwest of Highway 78/79 where the fire had jumped the Highway. The fire was calm in the Riverwood Estates area.

Looking west from Riverwood Estates towards the slop over above Highway 78/79 at 10:56 A.M. on October 29, 2003. (B.Smith.)

While Captain McDonald and his crew were doing structure protection in the Riverwood Estates, he had a discussion with members of the crew, including Engineer Rucker, concerning the use of hose packs. McDonald said that if there was a need to protect this structure, they would add to the 100' deployed hose lines an additional 100' length of hose from one of their 200' wildland hose packs.

Post fire view from south to north of Orchard Lane. Vehicles parked on side of the road are located just to the south of the driveway at 930 and 920 Orchard Lane.

At about 11:00 a.m. the Task Force Leader met with Division I who told him that he needed to move his Task Force to

Orchard Lane because there was an increase in fire behavior in this area requiring the apparent need for immediate structure protection.

There was no specific briefing of the Task Force at this time.

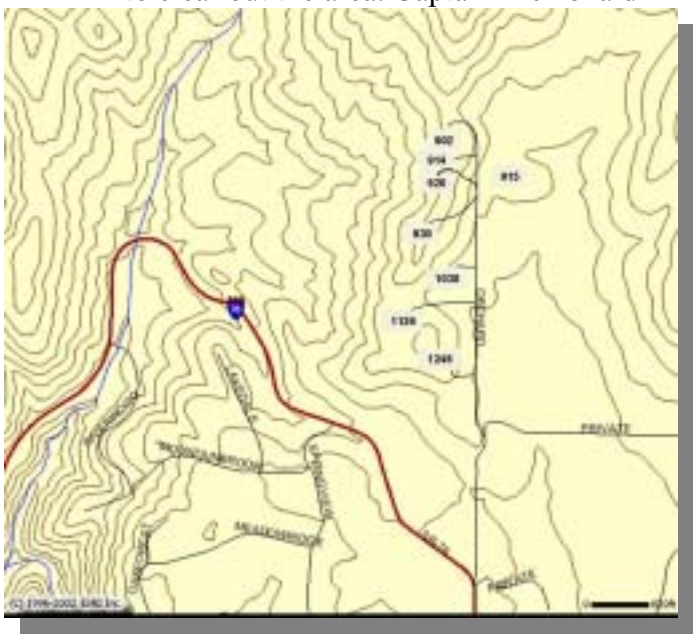
At about 11:45 a.m. the Task Force Leader drove North on Orchard Lane while the Task Force staged at the intersection of Orchard Lane and Highway 78/79. The Task Force Leader called back for the task force team to start moving up. At this time the crew of Engine 6162 observed the fire crossing Orchard Lane at the North end. At this time Engine 6162 was the last engine in line in the Task Force. At about 11:50 a.m. the Task Force arrived near 915 Orchard Lane. The Task Force Leader began scouting structure locations near the north end of Orchard Lane.

Post fire photo of the grazed field identified as a Safety Zone by Engine 6162 crew. (D. Northern)

Due to the fire activity that he observed at the North end of Orchard Lane Captain McDonald ordered his engine backed up to a grazed field on the East side of Orchard Lane identified by the crew as a Safety Zone. The other units of the Task Force backed up with them.

Engine 6162 was assigned to 920 Orchard Lane, the second home from the north on Orchard Lane by the Task Force Leader. Captain McDonald and the Task Force Leader discussed the placement of his engine, the need to deploy hoses, and to clear out the area. Captain McDonald and his crew were comfortable with their plan.

Captain McDonald ordered Engineer Kreps to back the engine up the cement driveway at 920 Orchard Lane. He walked up the driveway ahead of the engine to evaluate the location. Smith and Rucker cut brush that was hanging over the sides of the cement driveway, and directed the backing of the engine.



Map of Orchard Lane

After walking only as far as the residence detached garage, Captain McDonald returned to his engine. He had assessed the situation and expressed some concern about the conditions to his crew. McDonald radioed the Task Force Leader and advised him that he didn't think the house was defendable. The Task Force Leader told them to come out.

McDonald, Rucker, and Smith walked to the end of the driveway to assess the conditions closer to the structure. They continued past the front of the house, which faced west towards the San Diego River drainage and well beyond where Captain McDonald stopped on his first assessment of the area. They surveyed their location and found that the brush had been cleared away below the residence on the west side for about 150 feet. Because of the conditions they observed they decided the structure could be defended. Since the brush to the west had been cleared, there was a view across the canyon to the West and Northwest. Tall brush and drifting smoke restricted the view to the Southwest.

The single story stucco home had a composition type roof. From their location they saw smoke to the north (near 902 Orchard Lane) and determined it to be the main fire and their primary threat. They predicted this fire would continue to back down the ridge to their location and that it would remain a flanking fire.

Small runs of fire were occurring across the canyon on the west side of the drainage as the main fire backed down into the bottom of the canyon. No fire activity was visible to the Southwest. There was a wind blowing up canyon and up slope toward the location of 902 Orchard Lane. Wind speeds were estimated at 7-10 mph.

Fire on the ground north of the garage just before Kreps begins to fire out from this location. This is the same area where Capt. McDonald saw a CDF Captain that appeared to be preparing to conduct a firing operation from the top of the driveway. View is to the north towards 902 Orchard Lane (S. Kreps)

The crew of Engine 6162 was not aware of any other resources operating on Orchard Lane other than those assigned to Task Force 2005A. The crew was also not aware of the exact location of the other resources assigned to the Task Force.

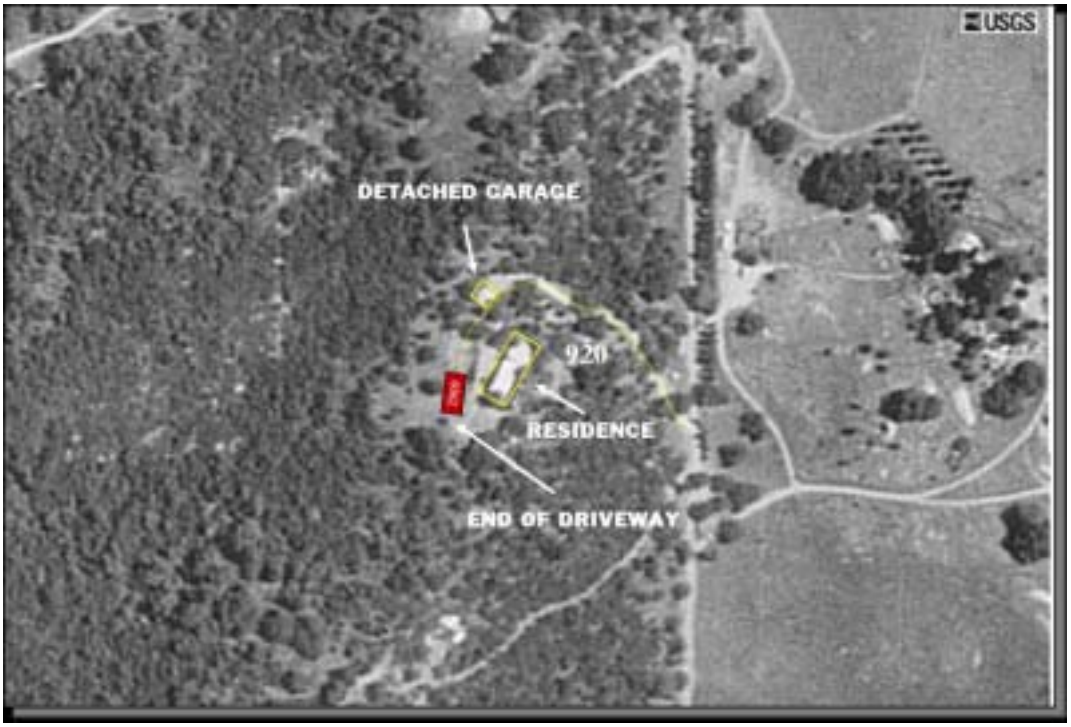
After Engine 6162 arrived at the top of the driveway at 920 Orchard Lane, McDonald conducted a briefing with the crew of Engine 6162 where he explained the plan of operations, structure preparation, LCES, Safety and Survival Plans. An axe was placed at the rear door of the structure in preparation for forcible entry, should it be needed. The chain saw was placed on a cement patio on the south end of the house after doing some additional brush clearing. The roof was laddered near the front door using a ladder found at the residence.

The crew charged the front bumper line to be used as an engine protection line. Two 100' long, 1 ½" hose lines were deployed and charged to protect the structure. These two hoses lines were wyed off a rear discharge on the engine.

The crew did additional work preparing the residence for the oncoming flanking fire from the north including the removal of additional brush down slope from the engine. They moved the brush away and backed the engine up about ten feet to avoid subjecting it to heat from a brush pile that they burned below the driveway.

Area below and to the southwest of Engine 6162 where brush had been cleared and crew strip burned grass stubble. Capt. McDonald threw fusees into brush below clearing.(R. Lopez)

Captain McDonald walked north on the driveway, and while near the front door of the residence, he saw a CDF pickup truck drive up to the top of the driveway and park near the garage. He observed a CDF Captain who he believed was preparing to conduct a firing operation near the garage. He



was not able to speak with him before he was out of sight, but Captain McDonald thought the CDF Captain saw him.

Captain McDonald met with his crew and told them there was a CDF Captain in the area of the garage that appeared to preparing to conduct a firing operation. Captain McDonald instructed his crew to fire out the stubble grass area below the driveway on the West side. This primarily grass area extended approximately 140' below the driveway before it reached the heavy brush line. Kreps walked down the driveway towards the garage area. He observed fire already on the ground behind the garage and to the north in the brush. Kreps believed that this was the main fire backing down the ridge as expected. He began his strip firing from that location to the south along the edge of the driveway. Captain McDonald threw fusees down the slope into the heavy brush line 140 feet below the area strip burned. None of the crew members noted any effect from the use of the fusees. None of the crew noticed exactly when the CDF pickup left their location.

At about 12:35 p.m., the Task Force Leader and his assistant arrived at 920 Orchard to check on Engine 6162's progress and plans. The sky was clear overhead and the winds were moderate, still up canyon and up slope. They spoke with Captain McDonald and discussed Engine 6162. The Task Force Leader told Captain McDonald he and the crew were doing a good job. The main fire was continuing to back down (flanking fire) the ridge from the North and was still about 300 yards north of their location.

Photo of the fire picking up over 140' below Engine 6162 just as the crew begin to return to the engine from firing out the stubble grass. (S. Kreps)

Engineer Kreps had to wait for several minutes to take the photo to the left because the primary fire activity at this time was isolated torching in the brush. In this picture minimal wind activity is observed and the smoke and flame are standing straight up indicating a minimal wind influence.

About five to eight minutes after the Task Force Leader left the scene, the crew of Engine 6162 observed an increase in the fire activity down slope from their location.

The Engine 6162 crew gathered at the engine to discuss the situation. As the fire intensity increased, the crew decided to move to the passenger side of the engine away from the radiant heat below them. At this point Smith staffed a 1 ½" inch hose line at the front passenger side while Rucker staffed a similar hose line near the rear passenger side. Engineer Kreps was standing at the rear duals on the passenger side with his back to the engine.

Captain McDonald remembers being just to the rear of Smith. Kreps recalls that all four members of the crew made it around to the passenger side of the engine and that they had been moving around, including walking to the tailboard of the engine. Kreps had his back to the engine rear duals, and Rucker was directly in front of him, no more than five feet away. Captain McDonald had the only portable radio. As Smith took his position at the front of the engine, he noticed hot embers blowing into the juniper bushes on the patio behind him. He used his hose to knock down some fire in the bushes.

At this point Engineer Kreps stepped around the rear of the engine and took the photo below. Rucker told Kreps to "Get Back". According to Kreps, when the photo was taken the conditions had not yet started to deteriorate. Kreps believes the photo was taken about 20 seconds before conditions began to change dramatically.

Behind the cover of the passenger side of the engine. (S. Kreps)

In the Kreps photo (left), taken from the rear of the engine, the burn pile can be seen beyond the engine. Fire activity at ground level as well the smoke appeared to be drawn to the South or Southwest. The engine was sitting on a flat driveway but the hose strap on the driver's side rear appears to be drawn away from the engine. Because the general wind conditions at the time were from the west there appears to be a local wind condition or drawing effect influencing the conditions around the crew of Engine 6162 . The sun was now above them and to the south. The convective column appeared to blocking out the sun at this moment. The fire approaching from the south or southwest, as described by Captain McDonald, can be seen in the reflections on the back of the engine.

Smith describes the conditions as changing from full sunlight when they went around the engine, to twilight then darkness with smoke and an orange glow with fire embers blowing past the engine. The heat intensity dramatically started to increase.

Kreps remembers that this is when the sky got dark, it started getting very hot, embers were flying everywhere, and it sounded like a freight train coming.

Captain McDonald remembers that at about this time, the sky started turning orange, and the conditions started to become untenable. According to Captain McDonald and Engineer Kreps, the majority of the heat was coming from the south or southwest.

Captain McDonald recalls seeing a huge orange glow as he looked backwards over the top of the rear of the engine. He could see the glow through the trees and tall brush. Engineer Kreps covered his mouth with his gloved hand and reminded himself to take shallow breaths to protect his airway.

The crew noticed a significant wind increase and then a flaming front was observed by Smith, blowing across the driveway in the direction of the garage, cutting off their egress to the Safety Zone in the field off of Orchard Lane. The Juniper and Boxwood bushes planted along the cement patio behind them burst into flames.

A post incident photo showing Steps leading up to patio. Path which crew members used to get up onto the patio. (D. Northern)

The situation was deteriorating and the crew decided that before it got any worse they should take refuge in the structure. At this time Captain McDonald ordered his crew to move to the shelter of the structure.

Smith, responded to Captain McDonald's order to get into the structure, immediately dropped his line and ran in the direction of the three-foot high raised patio. Once he left the protection of the engine, Smith experienced severe thermal conditions. He leapt past the burning bushes and onto the patio. He was followed by Kreps who ran to the steps, stumbled and fell to his knees at the top of the steps, but then recovered and continued to retreat behind the rear of the house following Smith. They both covered over 150 feet in their run from the engine to the rear door of the structure.

Captain McDonald moved toward the steps of the patio and accounted for Kreps and Smith while they ran onto the patio and around the rear corner of the house. He then turned back toward the rear of the engine to look for Rucker not understanding why Engineer Rucker was taking so long. Captain McDonald located Rucker standing near the rear of the engine where Kreps had last seen him. As Captain McDonald approached he noticed that Rucker appeared to be disoriented.

Although the CDF Green Sheet indicates that Engineer Rucker was wearing a hose pack, and that he put it on after the order to move to the house was given, none of the crew members have any recollection of Engineer Rucker donning or wearing a wildland hose pack at 920 Orchard Lane. Captain McDonald has no recollection of instructing Engineer Rucker to don a hose pack during the incident. These packs were located in the middle rear compartment of Engine 6162 . An inventory of the engine after the accident showed that one 200' wildland hose pack was missing from this compartment.

Captain McDonald began to yell for Engineer Rucker to move to the structure. Rucker was slow to respond then turned his head and almost started walking the opposite way. Captain McDonald continued to yell for Rucker to move towards the structure and Rucker responded by moving towards McDonald. Captain McDonald had to cup his hands to his mouth to be heard over the roar of the fire.

McDonald saw Rucker take two steps toward him and fall to the ground. McDonald witnessed him stand up, on his own. Engineer Rucker then turned toward the tailboard of the engine and according to McDonald may have taken a "half step" in that direction. McDonald remembers Rucker looking in a southerly direction, at the approaching wall of fire. McDonald saw Rucker step toward him and then turn toward the bushes along the patio, and fall face-forward into the burning bushes. Captain McDonald moved toward Rucker, who was already pushing himself away from the bushes. Captain McDonald assisted Rucker up and to the steps leading to the elevated patio. Rucker was able to make it up the steps under his own power, although he was slightly hunched over at the waist.

According to McDonald sometime between his first fall and when they reached the steps to the patio Engineer Rucker said "I'm burning up", McDonald did not witness any fire on Rucker and did not feel that he was personally being burnt.

Captain McDonald followed Rucker up onto the concrete patio where Engineer Rucker fell the final time. Engineer Rucker fell first to his knees and then face first on to the patio without any attempt to brace his fall. Engineer Rucker was not responsive at this time. Captain McDonald tried to get Rucker up but was not able to. According to the CDF Green Sheet, Captain McDonald made a firefighter down call on his portable radio at this time. Captain McDonald remembers dropping the portable radio when it became too hot to hold. Captain McDonald recalls turning 180 degrees and trying to pull Engineer Rucker up.

Captain McDonald yelled for the other two crew members to return but could not be heard due to the noise at this point of the fire. Captain McDonald he realized that he was now being badly burned and that Engineer Rucker was beyond help.

Captain McDonald made his way around the rear corner of the house.

Meanwhile, Smith and Kreps were at the rear door of the structure where they used the axe and multiple kicks to force the door open. They both entered the rear of the residence. Turning around, the two realized that they were alone. They returned to look for Captain McDonald and Engineer Rucker.

Smith and Kreps traveled back along the rear of the house to the south end, using the house as protection. As they neared the southeast corner of the house, they could see that beyond the end of the house there was a solid wall of flame blowing sideways and engulfing the patio. As they arrived at the corner, Captain McDonald staggered around the corner out of the flames. He appeared burned and dazed.

Captain McDonald told them that Rucker had fallen and they needed to go back for him. Captain McDonald turned to go back after the fallen Engineer. Based on their observations of the conditions Kreps and Smith determined the patio area was not tenable. Taking Captain McDonald with them, the three retreated back into the rear door of the residence.

Once inside the residence, Captain McDonald realized he was burning and took off what remained of his web gear. He searched for his King portable radio to call for help, but he no longer had it with him. The three discussed a plan to reach Engineer Rucker.

After a moment, a decision was made to open the front door slowly and check to determine if the outside of the house was tenable. When the door was opened, intense heat surged through the small opening. The door was quickly closed. After another few minutes, a decision was made to check the front door again. This time the heat had subsided and Kreps exited the doorway in search of the missing Engineer. Smith attempted to exit the door but was forced back by a wave of heat. He remained inside the residence and cared for McDonald.

Engineer Kreps moved toward the front bumper line of the engine taking small shallow breaths and using his shroud to protect his airway. As Kreps passed the front of the concrete patio, he saw the body of Rucker midway across the patio. The engine was still running at a high idle as he had left it. He continued to the bumper hose line and advanced it toward Rucker. He opened the nozzle, but only had 10 to 15 seconds before he ran out of water. The fire had burned through the rear hose lines on the engine and the tank had been pumped dry. The engine, however, appeared to be basically undamaged and drivable.

In an instant, the fire intensity increased, forcing Kreps to take shelter in the rear seat of the engine. Once inside, Engineer Kreps considered deploying the extra fire shelters stored in the cab. Recognizing there was nothing he could do for Engineer Rucker and concerned that Smith and McDonald would come searching for him, Kreps took a single breath and ran back to the front door of the structure. Smith, in the house, opened the door to go look for Engineer Kreps, who burst through the door at the same moment.

While the three of them sat inside near the front entrance of the house, the north end of the structure began to burn. Smoke banked down to waist level, dropping like a curtain, and a decision was made by the group to try to get back to the engine. Knowing there was no hope for Engineer Rucker and the house would soon be fully involved the three exited the front door and headed for the engine. Captain McDonald was assisted to the front passenger seat. Smith ran to the rear of the engine and disconnected the two protection lines. He got into the rear passenger seat while Kreps got into the driver's seat.

Engineer Kreps began to drive the engine slowly down the driveway toward the north heading for Orchard Lane. Heavy dark smoke obscured the driveway and Kreps was forced to feel his way down the concrete, using the feel of the tires as they dropped off

the edge of the concrete to make corrections. At one location he stopped the engine to avoid running off the road and being lodged against a tree. Kreps knew that there was a significant curve in the driveway, which if he missed it, would take them off the driveway and down a steep slope. The crew was still concerned about being overrun by the fire again. A gust cleared just enough smoke for Engineer Kreps to make an adjustment and they were able to move forward again.

During the descent of the driveway, Captain McDonald was able to transmit a fire fighter down message on Command Net using the mobile radio.

Kreps drove to the bottom of the driveway and onto Orchard Lane and then headed south. Captain McDonald made another announcement on the Command Net using the mobile radio. Inexplicably, Captain McDonald ordered the engine to stop in the road and he got out. The crew members immediately assisted him back into the engine. They continued towards Highway 78/79.

At about 1:10 p.m. the three members of the crew in Engine 6162 arrived at south end of Orchard Lane at a location just short of Highway 78/79 where they found the Plumas Hotshots. The three crew members of Engine 6162 exited the engine and announced to the Plumas Hotshot crew that they have been burned. Advanced Life Support (ALS) ambulances and medical helicopters were requested.

Captain McDonald was triaged as the most severely injured with 1st, 2nd, and 3rd degree burns, as well as burn damage to his airway. Captain McDonald was in need of immediate ALS intervention. Prior to being treated for their own burns, Kreps and Smith, the only paramedics at the location, used the ALS equipment from their engine to start two IVs on Captain McDonald.

At about 1:25 P.M., the first Julian Paramedic Ambulance arrived at Engine 6162's location. Kreps insisted that McDonald be transported in an ALS helicopter with a nurse so he could be paralyzed and intubated (RSI-rapid sequence intubation) prior to arriving at the burn center. McDonald was packaged and transported to a landing zone where he was met by CDF helicopter 202 at 1:52 p.m. Copter 202 then transported McDonald to Ramona Airport to rendezvous with a Mercy Air Helicopter. Captain McDonald was transferred to the Mercy Air Crew who RSI'd him and transported him to the University of San Diego Burn Center.

At about the same time CDF Copter 406 transported Kreps and Smith to Ramona Airport to rendezvous with another Mercy Air Helicopter. A Paramedic treated Kreps and Smith on this flight. They were transferred to the Mercy Air Crew for transport to the University of San Diego Burn Center.

Cedar Fire Recovery Team

The Recovery Team identified a large number of findings based on their review of the events that led to the Cedar Fire burnover incident; the findings have been organized into nine subject categories:

1. ALS Equipment
2. Apparatus
3. Communications
4. Equipment
5. Fire Behavior
6. Personnel Protective Equipment
7. Training and Experience
8. Policy and Tactics
9. Human Factors

Significant Findings

There were many findings identified for each of the nine subject categories. Some of the findings did not play any role in the Cedar burnover however they were identified as issues that needed to be addressed within the Novato Fire District and in some cases by the fire service in general.

In order to provide the reader with a complete picture of the situation these findings are displayed in three time phases related to the incident, Pre Incident, Incident and Post Incident Considerations.

The Novato Fire Protection District hopes that the information and issues identified in this report will lead to improved firefighter safety and survival in the future.

Lessons Learned
ALS Equipment

Pre-Incident

- All Novato Fire District Type I Engines and Ambulances are ALS equipped and staffed with Paramedics. The District Truck/Medium Rescue Company is ALS equipped but typically not staffed with Paramedics. Type III Engines are BLS equipped.

- 65 out of 70 of the District line personnel are or have been State licensed and County accredited Paramedics. As members promote, the current MOU allows them to maintain State Licensure without County Accreditation. Paramedics without County Accreditation operate at the BLS level.

- All County Accredited Paramedics are certified in Expanded Scope Skills which include nasotracheal intubation and Advanced Cardiac Life Support (ACLS).

- The EMS Division is managed by a Battalion Chief who is also a Paramedic. The Division includes a full time Medical Director/EMS Educator who is a licensed Physician and certified Paramedic. All EMS continuing education classes are provided in house by the EMS Division.

- In a pre-Cedar Incident EMS Continuing Education class, the Medical Director/EMS Educator conducted a class on recognizing the need for Rapid Sequence Intubation (RSI). Specifically discussed was the need to hyper-oxygenate for a period of 15 minutes prior to performing the RSI procedure.

- RSI is used to chemically paralyze the conscious patient in respiratory distress so that the airway can be secured with an endotracheal tube. RSI is not currently included in the scope of paramedic practice in the State of California.

Incident

- The crew of Engine 6162 was made up 4 current or past Paramedics. Captain McDonald is a former Paramedic, Engineer Kreps is a State Licensed Paramedic, Engineer Steve Rucker was a County Accredited Paramedic as well as FF/PM Smith.

- Recognizing that Engine 6162 , a Type III Engine, was only BLS equipped, Engineer Kreps and FF/PM Smith placed two 1000cc IV bags, tubing and start kits on the engine as a precaution prior to departing Novato.

- Following the burn over at 920 Orchard Lane the crew of Engine 6162 realized that Captain McDonald was significantly burned. The crew proceeded, in Engine 6162 , to the intersection of Orchard Lane and Hwy 78 where other fire crews

were staged. Upon arriving Engineer Kreps and FF/PM Smith determined that they were the only Paramedics at that location.

- While injured themselves, they performed an Advanced Life Support (ALS) assessment on Captain McDonald. They determined the immediate need to secure his airway due to thermal burns. Captain McDonald was still conscious and exhibiting signs of respiratory distress.

- As a result of the continuing education class, on RSI, Engineer Kreps recently attended, he recognized Captain McDonald as a candidate for RSI. Also recognizing there was no equipment or trained personnel capable of delivering RSI, Engineer Kreps and FF/PM Smith requested a medical helicopter with RSI capability.

- While waiting for transportation, Engineer Kreps and Firefighter/Paramedic Smith established two large bore IV lines on Captain McDonald.

- Captain McDonald, Engineer Kreps, and FF/PM Smith were transported by ground ambulance to a helispot where they met up with a CDF helicopter. Engineer Kreps instructed the CDF crew to hyper-ventilate Captain McDonald for 5 minutes anticipating that the Air Ambulance would RSI him before transport to the burn center.

- The CDF helicopter transported Captain McDonald to Gillespie Field in Ramona, where he was transferred to an Air Ambulance helicopter. The Air Ambulance crew performed RSI on Captain McDonald on the tarmac at Gillespie Field. Captain McDonald was then transported to UC San Diego Hospital Burn Unit.

  Captain McDonald sustained respiratory burns to 30 percent of his lungs and upper airway. He also sustained second and third degree burns over 28 percent of his skin.

Post-Incident Considerations

1. The Fire District has debated placing ALS equipment on Type III Engines for several years. The reasons the equipment was not placed on the Type IIIs were: lack of consistent paramedic staffing, available space on the engine, the cost of purchasing and maintaining the ALS equipment, the perceived need and frequency of use.

2. The ability to immediately secure and control an airway is vital to the patient's survival. The recognition of the need to initiate RSI on Captain McDonald greatly enhanced his survivability. While performing ALS procedures without all of their equipment, technically out of their scope of practice, the early establishment of IVs allowed the Air Ambulance crew to perform RSI faster. This also enhanced Captain McDonald's survivability.

3. The immediate availability and strategic deployment of trained and equipped Paramedics rather than EMTs on the fire ground enhances the survivability of firefighters and civilians.

4. Further, the availability of ALS medical personnel on the fire ground to promptly provide RSI will enhance the survivability of firefighters and civilians. It is far more important to rapidly secure the airway than it is to promptly provide BLS air transportation. Airway management applies to burns and traumatic injuries as well as medical emergencies.

5. RSI should be included in the Paramedic scope of practice in California.

Lessons Learned
Apparatus

Pre-Incident

- The Novato Fire District cross staffs two Type III engines, with three to four personnel, using crews assigned to engine and truck companies. Engine 6162 operating at 920 Orchard Lane was one of these two engines.

- The District Type III engines meet NFPA 1901 and 1906 Standards and exceed the FIRESCOPE ICS Primary Mobile Suppression Resources Minimum Standards in pump size, tank size, hose compliment and equipment carried. These engines have been designed to equal capabilities in both the urban interface and pure wildland environment. In regard to features they are very similar to the CDF Model 14.

- In addition to the FIRESCOPE requirements, all Novato Fire District Type III engines are four wheel drive, equipped with 500 gpm pumps, high band mobile and portable radios, SCBAs with spare cylinders, stored in external compartments, drip torches, fusees, chain saws, 16' ladder, BLS medical equipment, Class A Foam and 500 gallon water tanks. The engines are 8.5' wide, mirror to mirror, 9 feet 4 inches in height, 9 feet 8 inches in width, 24 feet in length with a 160 inch wheelbase. A 50' single jacket engine protection line with nozzle is stored in the engineer's compartment.

- The District uses a VHF low band radio system for day to day operations, however, all engines are equipped with a VHF high band mobile and portable radios for mutual aid purposes. External speakers exist for the low band system however; the high band system is not audible through these external speakers. When available, crews responding to "Out of County" incidents are provided additional high band portable radios.

- Emergency warning, electronic strobe lights exist on all four corners of the engines.

- All District engines have diamond plate hose bed and live line covers. The ends of all hose beds are secured with vinyl flaps and held in place by nylon straps.

- All units are custom design built with 4 door enclosed cabs on commercial chassis. Numbers indicating the engine unit inventory number have been placed on the roof of all Type III engines. Unit inventory numbers differ from the engines radio designator.

    a. Example: The unit inventory number for Engine 6162 is Unit 18. U-18 is displayed on the roof of the engine, not Engine 6162.

- As units are reassigned, the District currently changes their radio designator number to correspond to the station that they respond from for Computer Aided Dispatch purposes (CAD). Example: If Engine 6161 is taken out of service, the reserve unit that replaces it would assume the radio designator Engine 6161.

- The internal configuration of the cab is standard for a 4 door commercial chassis engine, high back bucket seats in the front, divided by a console and a CAD Mobile Data Terminal on a pedestal. The rear of the cab is configured with standard bench seats.

- Additional fire shelters are carried in the cab to facilitate the ability of the crew to shelter in the engine. Hooks are provided to provide easy access to member's wildland FSS web belt with shoulder harness.

- Sufficient storage space is provided so that combustible material, such as PPE storage bags and personal gear bags are not exposed.

- The District Type I engines are equipped with spark arrestor screens on all engine air intake ducting to prevent embers from igniting the air filters, however the Type III engines are only equipped with non-combustible air cleaners. Spark arrestor screens are not provided on Type III engines because they obtain their air from under the enclosed hood.

Incident

- At the time the crew of Engine 6162 was operating at 920 Orchard Lane there were two 1.5" wildland single jacket hose lines, each 100' in length, deployed from a gated wye attached to a rear discharge of the engine. Additionally a there was one 1.5" Nitrile single jacket hose line, 30' in length, deployed from the front bumper discharge.

- The engine's pump was engaged and operating. The engine was backed into the driveway and parked facing out.

- All windows were rolled up, spotlights were on and turned upward and the headlights and marker lights were on. Emergency lights were not on at the time of the incident.

- When it appeared that the situation was beginning to deteriorate Engineer Kreps increased the rpm on the engine from the pump panel. The pump was left engaged and the two 1.5" lines were left charged. Up to this point minimal water had been utilized.

- During the burn over Captain McDonald, Engineer Kreps and Firefighter/Paramedic Smith all reported embers blowing erratically under the engine as well as intense heat from the downhill side of the engine and extreme

heat from the rear of the engine. The tires on the engine were utilized as a heat shield prior to seeking safety in the house.

- As a result of the burn over the charged rear hose lines were destroyed. The remaining water in the tank was emptied through the burned hose lines because the pump remained in gear. The front bumper line was not damaged due to the burn over. The engine did not stall nor did it sustain damage that prevented it from being driven to safety.

- The engine sustained only a few small paint blisters on the driver's side near the back of the engine near the top of the cabinets. The vinyl hose bed flaps were burned off on the driver's side and rear of the engine. The strobe light lenses were melted on the rear, driver's side and passenger side (excluding the cab). The lenses on the front of the engine showed minimal deforming and remained intact along with those on the cab on the passenger side of the engine. The light bar showed signs of deformation but remained intact.

- There was no other damage to Engine 6162 and it passed its annual pump test following its return to the District.

- Several minor air leaks were found in the plastic air lines, however it is unknown if they are related to the burn over.

- The home at 920 Orchard Lane used a well system for its water supply. At the time of the incident the power was out to the area and there was no water available at the house, therefore there was no effort made to re-supply the engine water supply with a garden hose.

- The homeowner's ladder was used to ladder the roof of the house in the area of the front door.

Post Incident Considerations

- Due to the combustible nature of plastic/rubber air lines, wiring and other critical undercarriage components, these components should be protected from thermal damage during vehicle design. Further consideration should be given to after market modifications for those units currently in service.

- Care should be given to keeping the undercarriage clean of grease, oil and other combustible products.

- Specific attention should be given to installing high temperature fuel lines, protecting wiring from the battery to the engine computer system and protecting air lines so that the brakes would operate properly in a burn over or other similar event.

- The actions taken by Engineer Kreps to throttle up the engine most likely prevented it from stalling during the burn over. Training should include the awareness that abandoned hose lines may burn through and cause the depletion of water supply if discharge valves are left open when the pump is engaged. In this case the pump was left engaged and valves open because the hose lines were needed. When the conditions changed quickly there was no time, nor was it safe to disengage the pump or close the valves.

- The diamond plate hose bed covers performed appropriately to provide a barrier between the combustible hose bed and the burn over environment. No un-deployed hose was damaged in the burn over. However, the vinyl flaps and nylon straps securing the hose beds were destroyed. Hose beds and securing systems, should be fully protected using non-combustible material.

- There have been several internal debates as to which number should be on the roof of the engines as well as if numbers should be used at all. There was no issue with roof numbering during the burn over of Engine 6162. Concern exists however, that if contact from the air utilizing the U-18 designator was attempted, the crew or the Task Force Leader may not have realized that it was their unit because unit inventory numbers and radio designators are different. A method to clearly identify the District apparatus from the air needs to be developed.

- The crew of Engine 6162 was able to enter the engine from both sides following the burn over. However, if the entire crew had been forced to enter the cab from the passenger side or rear, the center console and MDT may have prevented the engineer from quickly accessing the driver's seat, slowing the escape of the crew.

- The enclosed cab environment maintained the interior cab integrity of Engine 6162 and aided in the survivability of the crew during their escape. While smoke within the cab was not a factor and SCBA cylinders were not placed in the cab, consideration should be given to using SCBA cylinders to pressurize the interior of the cab. However, in this situation the cab remained clear.

- In 1996 the Missoula Technology and Development Center studies in Los Angeles County determined that the materials inherent in fire engine cab construction caused smoke from gases released from the plastic and vinyl interior components to fill the cab in burn over situations. Additionally it was determined that the engine cab could only be a survivable environment during short duration, low-to moderate-intensity fires. Until recently very little effort has been made to protect the crew inside of the cab of the engine in a burn over situation.

    - There are other methods of protecting the crew currently available and some of which have come from studies of engine burnovers in Australia.

    - Australia has been using an external mounted sprinkler system for some years that has proven to be effective when there is a sufficient on board

water supply. Other methods include permanently mounted fire curtains, similar technology to fire shelters, inside the cab of the engine that can be quickly deployed to protect the crew. In addition one engine manufacturing company is building a wildland or wildland interface engine with a track-mounted fire curtain window protection system that includes double-panel thermal windshield glass and high temperature-tempered side windows. The Track system allows for rapid deployment to minimize setup time during emergencies. There are also high-temperature door gasket materials, a fully insulated cab interior and an all aluminum cab for maximum heat dissipation.

- Engine 6162 experienced difficulty leaving 920 Orchard Lane due to the narrow winding driveway which was obscured by smoke. Research indicates some automobile companies offer nighttime vision aids by projecting near-infrared beams from two lamps in the front bumper. The near-infrared light reflects from objects ahead back to a Charged Coupled Device (CCD) camera mounted inside the vehicle at the top of the windshield.
    - A dedicated computer processes the resulting natural-looking images, which are then projected onto the lower section of the windshield within the driver's field of vision. This results in a picture similar to that on a black and white television. This system delivers clear illuminated images of what is ahead out to a distance of nearly 500 feet. In the event that is necessary to operate the vehicle in a zero visibility situation this system may allow for the safe and quick escape of the crew. Current versions of this system have a field of vision of 1500 feet and cost approximately $10,000.00.
    - Engines carrying Thermal Image Cameras may find them useful in situations when visibility is obscured by smoke.
- A standard should be developed or refined, such as NFPA 1901 and 1906, for the design and construction of wildland and wildland interface engines with a focus on crew safety and survivability, since the technology appears to currently exist to meet these standards.

Lessons Learned
Communications Equipment

Pre Incident

- During the day to day operations, the Novato Fire Protection District equips each Type III engine with the following radios:
  - VHF High Band Mobile: One Kenwood TK-790 multi-channel, scanning radio, with external radio speaker. The radio is programmed with Marin and Sonoma County local government, CDF and NIFC frequency banks.
  - VHF Low Band Mobile: One Motorola MaraTrac multi-channel, scanning radio with external radio speaker. The radio is programmed with Marin County local government frequencies.
  - VHF High Band Portable: One Bendix King EPH/EPI Series multi-channel, scanning radio with onboard charger and backup "clam shell" with AA batteries. The radio is programmed with all Marin and Sonoma County local government, CDF, USFS and NIFC frequency banks. 2 of the 15 available frequency banks are left blank for incident cloning.
  - VHF Low Band Portable: One Motorola MT-1000 multi-channel, scanning radio with onboard charger. The radio is programmed with Marin County local government frequencies.
- Day-to-day Fire District operations are dispatched and conducted on low band frequencies.
- The Novato Fire Protection District also maintains a cache of high band and low band portable radios for use during greater alarm incidents and mutual aid responses.
- At the time of the Cedar Incident the availability of spare high band portable radios from the radio cache had been diminished due to the fact that 2 other Novato Fire Protection District engines were committed the mutual aid assignments in Southern California.
- When Engine 6162 responded to the Cedar Incident, the crew was equipped with two Bendix King high band portable radios.
- Individual crew members responded with their personal cellular telephones. No Fire District cellular phone was installed in Engine 6162 . The one extra Fire District cellular phone assigned to operations had been used by the crew responding on OES E235 two days prior to Engine 6162 responding to the Cedar Fire.

Incident

- The Task Force Leader of XAL2005A directed the engines to utilize White 2, a State of California high band channel, as their inter-crew travel channel to San Diego.

- When the Task Force arrived at the Cedar Incident Base on October 28, 2003, the crew had their Bendix King portable radios cloned with the incident frequency load by the Communications Unit. The incident frequency load was cloned onto one of the two blank frequency banks.

- The crew of Engine 6162 received a briefing on the Communications Plan from the Communications Unit while the high band Bendix King radios were cloned with the incident frequencies on the afternoon of October 28.

- On October 28, the crew of Engine 6162 loaned one of their Bendix King radios to the Task Force Leader. The radio was loaned because the Task Force Leader did not have a high band portable. This left the crew of four on Engine 6162 with one High Band Bendix King radio.

- No other high band portable radios were available from the Communications Unit at the time.

- At the time of the burnover Engine 6162 was communicating on the appropriate Tactical and Command Channels.

- During critical periods of their operations, communications between crew members of Engine 6162 were effectively conducted by means of face-to-face. Radio communications were not a factor at this time.

- Captain McDonald's Bendix King portable radio was dropped on the patio adjacent to the house and burned. It is apparent that the radio was dropped by Captain McDonald while attempting to rescue Engineer Rucker after making a "firefighter down" announcement.

- Mobile communications equipment on Engine 6162 remained undamaged and intact during the burn over. Captain McDonald made a mayday call on the Command Channel using the high band Kenwood mobile radio during their escape from 920 Orchard Lane.

- Once Engine 6162 made it to a safe area, subsequent radio communications were effective in coordinating their medical evacuation and apprising the Incident Command Team Command Staff of what had occurred.

Post Incident Considerations

- An external high band speaker would have enhanced the communication ability of Engine 6162 in the absence of high band portable radios for each crew member.

- Supplying all engine crew members with portable radios capable of transmitting and receiving on the tactical and command frequencies assigned to the incident would enhance firefighter safety and provide redundancy due to failure or loss. After giving their second portable radio to the TFL the crew of Engine 6162 had one portable remaining. This radio was with Captain McDonald and was destroyed in the burnover. If they had not been able to make it back to the engine or if the engine had been damaged, they would not have had the ability to request the assistance necessary for survival.

- Any change in the Communication Plan impacting tactical resources must be communicated to all of those resources and a confirmation received from them acknowledging the change. TF XAL2005A was aware of a change in the plan since they had their radios updated the morning of October 29.

- The ability to manually program the portable and mobile radios may be valuable when cloning services are not available.

- Having both onboard chargers and "clam shell" backup battery power with extra batteries is essential to reliable radio operations.

- The Communication Unit should be used to obtain or replace radios. Loaning radios between members of a Strike Team or Task Force should be considered as a last resort. All resources should respond to incidents with the appropriate radio equipment.

- Ideally the Communications Unit should have sufficient portable radio supplies to meet the anticipated needs on the incident. In times of extreme drawdown this will not always be possible. Responding resources should not rely on solely on the ability of the Communications Unit to provide communications equipment.

- The utilization of separate radio frequencies, other than the assigned incident tactical frequencies, for intra-crew communications, can lead to situations where resources may be unable to transmit or receive critical incident information. Strict adherence to the incident assigned frequencies should be maintained by all resources.

- Consideration should be given to installing cellular phones in all suppression apparatus.

- If assigned tactical frequencies are overloaded with radio traffic, this situation should be communicated through the chain of command for the command staff to resolve.

- Despite the life threatening conditions encountered by Engine 6162, the May-Day transmissions made by Captain McDonald were clear and concisely relayed the severity of the situation.

Lessons Learned
Suppression Equipment

Pre Incident

- The District Type III engines meet NFPA 1901 and 1906 Standards and exceed the FIRESCOPE ICS Primary Mobile Suppression Resources Minimum Standards in pump size, tank size, hose compliment and equipment carried. These engines have been designed to equal capabilities in both the urban interface and pure wildland environment.

- In addition to the FIRESCOPE requirements, all Novato Fire District Type III engines carry the following equipment pertinent to this incident and not covered in other sections of this report.

- Hose Bed

  - Single bed, 600' flat load with 3" double jacket, synthetic supply hose in 50' lengths with 2.5" NS couplings. The supply line is terminated with a 2.5" x 2.5" clappered Siamese.

- Livelines

  - One wyed bumper discharge with one 1.5" Nitrile single jacket hose line, 30' in length with a 20/60 gpm wildland fog nozzle and one 1.5" Nitrile single jacket hose line, 30' in length with a 30/50 gpm stacked smooth bore wildland nozzle. Both nozzles are equipped with removable bales.

  - Two liveline crosslays, 1.5", synthetic, double jacket, 150' in length with combination 30-200 gpm fog nozzles. Both nozzles are equipped with removable bales.

  - One rear wildland liveline, 1.5" cotton single jacket, 150' in length with a 20/60 gpm wildland fog nozzle and removable bale. A Siamese is inserted at end of the first 50' length to facilitate another engine taking over the supply of the line.

- Wildland Hose Packs

  - 8 hose packs carrying two 100' sections of 1.5" single jacket, cotton wildland hose each (for a total of 1600'). The packs are made of a nylon type material and are capable of deploying individual lengths of hose without pack removal. One length of hose in each pack is equipped with a 1.5" x 1" tee. Each pack weighs 46.5 pounds. Four of the packs are carried in the left rear compartment and four are carried in the front left of the supply hose bed.

- Mop Up Kits
  - 4 hose packs carrying two 100' sections of 1" single jacket, cotton wildland hose each (for a total of 800'). The packs are made of a Cordura nylon material. Each pack carries a 1.5" x 1" tee, Forester style hose clamp, 10/24 gpm wildland fog nozzle without bale. *1" wildland hose is ***only*** used for mop up purposes.
- Engine Protection Line
  - One 50' length of 1.5" double jacket cotton hose with a 20/60 gpm wildland fog nozzle carried in a side compartment.
- Web Gear
  - See PPE Section
- Firing Equipment
  - Two orchard style drip torches
  - One 2.5 gallon dip torch fuel can
  - One case of wildland fusees
  - 4 fusee removable pouches, made of Cordura nylon, capable of being attached to the FSS web gear and shoulder harness with 5 fusees each.
- Chainsaw
  - One 031 Stihl with XX" bar with wood cutting chain
  - One combination fuel/oil can
  - One falling kit including, chaps, hearing protection, wedges and saw repair kit
- Weather Kit
  - One Forest Service belt weather kit
- Maps
  - One state Thomas Bros. guide
- Out of County Kits
  - The District maintains several kits that are placed on engines at the time of dispatch intended to provide personal support and essential equipment. These kits contain personal hygiene items, sleeping, cooking and rations. The kits are carried in the FSS style "Red Bags". Prior to departure a cooler is also

added and filled with bottled water and sports drinks. Room is designated on each engine for this equipment. No other comfort or entertainment items are carried and no combustible items are allowed on the exterior of the engine.

- Medical , see ALS equipment section
- GPS
  - GPS units are carried on all Chief Officer vehicles but not on the Districts engines.
  - Captain McDonald took his personal GPS unit with him on this incident

Incident

- At the time the crew of Engine 6162 was operating at 920 Orchard Lane the following equipment was utilized:
  - The wyed bumper discharge 1.5" Nitrile single jacket hose line, 30' in length with a 20/60 gpm wildland fog nozzle was deployed to control the burning operation on the existing brush piles near the engine. The brush piles were ignited by the crew to reduce the fuel load near the house. Engineer Rucker was using this line to maintain control of the intensity of the brush piles.
  - This line was left charged and placed on the front bumper of the engine as fire conditions began to intensify. As Engineer Kreps exited the house for the first time to locate Engineer Rucker, he found the line charged and intact. Engineer Kreps was able to utilize the line for approximately 15 seconds until the water supply was exhausted. Subsequently, when the crew entered the engine to depart 920 Orchard Lane the bumper line was still deployed and intact. In exiting the driveway the line was driven over and damaged.
- At the time the crew of Engine 6162 was operating at 920 Orchard Lane there were two 1.5" wildland single jacket hoselines, each 100' in length, deployed from a gated wye attached to a rear discharge of the engine. This is a standard Novato Fire District company evolution for structure protection operations. District personnel are discouraged from using hose lines over 200' in length for structure protection.
- One of the eight wildland hose packs was used to form the two 1.5" structure protection lines attached to the rear of the engine. These lines were deployed and charged in preparation for structure protection and fire control. These lines were not staffed until the crew took refuge behind the engine. At that time Engineer Rucker staffed one of these lines near the tailboard of the engine on the passenger side. FF/PM Smith staffed the other line near the front bumper on the passenger side of the engine.

- Both hose lines were substantially burned as a result of the burn over and unusable. The nozzles and gated wye remained structurally intact.

- The remnants of a second hose pack were found on the concrete patio near Engineer Rucker's body following the burn over.

- The drip torches were used by FF/PM Smith and Engineer Kreps to conduct a low intensity burnout operation including the ignition of a existing burn pile, light down slope surface fuels and ornamental vegetation along the west facing driveway near the home. Captain McDonald threw several fusees down slope into the manzanita below the grass line. The operation using the drip torches was effective in reducing the grass and ornamental vegetation below the engine and along the driveway. The fusees had little or no effect in igniting the manzanita.

- The chainsaw was initially used to remove a few overhanging limbs and a minor amount of brush along the driveway to 920 Orchard Lane to improve access/egress. It was later placed on the patio along the escape route to the house. The chainsaw was burned beyond operability.

- The weather kit was not utilized to monitor weather conditions during the operations at 920 Orchard Lane. It should be noted that the weather conditions, obtainable by a belt weather kit, just prior to the burnover were not necessarily indicative of what was going to occur. The temperature was in the low 70s and the relative humidity was approximately 30%. Winds were estimated to be 7-10 mph.

- A falling axe from Engine 6162 was placed by the rear door of the house prior to the burn over and used to force entry into the house.

- A McLeod was placed at the rear of the engine on the passenger side, next to the rock wall.

Post Incident Considerations

- The single jacket structure protection hose lines burned through. Research should be conducted to evaluate alternate hose types that would offer improved survivability in similar conditions, e.g. the 30' nitrile hose on the front bumper did not burn.

- Due to the combustible nature of the hose packs, consideration should be given to the materials used in there construction or to the ease that they can be removed in an emergency.

- This fire, even after several days, was understandably still being fought using initial attack and "bump and run" strategies without adequate overhead supervision. To effectively and safely operate under these conditions it is

essential for the Strike Team/Task Force Leader to have the ability to quickly access key accurate situational information, such as spot weather forecasts, fire history maps, live and dead fuel moisture and fire behavior predictions.

- Consideration should be given to providing all Strike Team/Task Force Leaders or engine companies with the training and capability to quickly and continuously access current and expected weather conditions (preferably from local RAWS locations), topographical maps, street maps, aerial photos, current and predicted fire behavior and conditions, expected local weather conditions, fire weather watches and warnings, fire history and any other pertinent information that would improve situational awareness and safety. Technology in the form of wireless communications capable of linking to an incident web site may provide this information quickly and continuously to the resources that need it to operate safely.

- Regardless of the perceived weather conditions weather should be taken on a regular basis using what ever means that are available to the crews or Strike Team/Task Force Leader.

- All responding resources should be appropriately equipped for the assignment. This responsibility falls on the agency filling the assignment, the responding crew, and ultimately on the STL or TFL.

- GPS units may provide crews with information regarding local topography and geographical locations in the event of an emergency.

Lessons Learned
Fire Behavior

Pre Incident

- There was no previous recorded fire history in the San Diego River Drainage in the immediate area of 920 Orchard Lane for at least 75 years according to available fire history maps. This information was not available to the crew of Engine 6162.

- The entire Southern California region had been in a drought condition for several years. The specific area of the incident had been in a drought condition for the previous three years with rainfall totals less than 60% of normal. Again, this information was not available to the crew of Engine 6162.

- The Cedar fire had burned approximately 233,000 acres by the afternoon of October 28.

- Annual grasses were predominate on the eastern aspect of the San Diego River drainage across from Orchard Lane along with isolated stands of chaparral and live oak. The predominate fuel model on the east side (west aspect) of the San Diego River Drainage, below Orchard Lane, was at least 30 year old chaparral (manzanita) with short annual grasses. Locals state that the chaparral fuel beds were nearly 70 years old. The chaparral fuel beds were approximately 15' in height with closed canopies. The age of the fuel was not known to the crew of Engine 6162 .

- Approximately 1.5 miles southwest of the entrapment site, 11 fire fighters were killed in a fire storm on the Inaja Fire. The Inaja Fire started November 25, 1956, under strong Santa Ana winds, the fatalities occurred when the winds turned to the west. *(CDF Cedar Fire Green Sheet)*

- On the east slope of the San Diego River Drainage, immediately below the driveway to 920 Orchard Lane, there was a 150' buffer of short annual grasses and duff between the driveway and the chaparral fuel bed.

- The slope below 920 Orchard Lane was approximately 20 percent however, the slope did increase to 30-40% near the bottom of the San Diego River Drainage.

- The elevation of 920 Orchard Lane is 3442'.

- There were East winds for the first three days of the incident which started on the evening of October 25, 2004 in the Cedar Creek Drainage. On October 28 offshore winds had subsided and the on shore winds developed by late afternoon.

- By 0900 hours on October 29 the fire was burning in the bottom of the San Diego River Drainage, North of Highway 78/79. A strong on shore pressure gradient developed by 0930 hours on the October 29 and a "Fire Weather Watch" was issued. Winds became increasingly gusty, southwest to west, with speeds of 15 to 30 mph in the higher elevations. Following the burn over, later in the afternoon the Red Flag Watch was upgraded to a Red Flag Warning due to the increased wind conditions and lowering humidity. The fire weather watch information was not made available to the crew of Engine 6162.

- The Julian RAWS at the time of the accident indicated a sustained wind speed of 17 mph with gusts to 31 mph from the west. The Julian RAWS is 4 miles to the southeast at an elevation of 4420 feet.

- As stated in the Training Section, The Novato Fire District has found that, in Marin County, the recurrence of the on shore weather pattern in the days immediately following a north/east wind event yield conditions that are most likely to result in a large-loss/acreage fire when fuel moistures are still low and the onshore winds increase.

Incident

- The Task Force stopped in Santa Ysabel at approximately 9:15 hours on the morning of October 29 prior to their first assignment of the day. They were told by their Task Force Leader that their assignment would be structure protection in the Riverwood Estates approximately 2 miles east of Santa Ysabel, off Highway 78/79.

- FF/PM Smith photographed the fire that had crossed Highway 78/79 enroute to this assignment. At this point the fire was burning primarily in the chaparral and oak woodland, making slow side hill progress under mild wind conditions. The crew states that the fire behavior was uneventful as viewed from Riverwood Estates.

- The Task Force spent approximately one hour on mop up operations following a firing operation that occurred earlier around the homes in the Riverwood Estates. During this time the fire remained some distance from the homes and was never a direct threat to the area.

- At approximately 11:30 hours the Task Force left the Riverwood Estates and proceeded East on Highway 78/79 towards Orchard Lane.

- Around 11:45 the Task Force turned North onto Orchard Lane. Orchard Lane is a single lane dirt road, approximately one mile long, that runs North off of Highway 78/79 parallel to the East side of the San Diego River Drainage. As Engine 6162 reached the end of the road the crew noticed the fire had wrapped around the northernmost end of Orchard Lane and was actively moving in a northeasterly

direction. Captain McDonald became concerned that the Task Force was not in a safe location and ordered Engineer Kreps to back Engine 6162 down the road to an area that appeared to be an acceptable Safety Zone.

- At roughly 1200 hours Engine 6162 was given the assignment to provide structure protection at 920 Orchard Lane. When they reached the ridgeline location of 920 Orchard Lane they observed the conditions in the area as described in the Pre-Incident description. The crew also noted that the clearance of brush below the driveway (buffer zone) provided for a view across the San Diego River Drainage to the west and northwest. Their view to the southwest was obscured by smoke, brush and live oak trees.

- As the crew looked at the west side of the drainage, they observed a flanking fire backing down towards the bottom of the San Diego River drainage. The crews view to the south and southwest was blocked. Smoke from the fire that had crossed the end of Orchard Lane was visible to the North. The crew describes an up canyon wind, 7-10 mph blowing to the northeast towards 902 Orchard Lane. The crew based their decision to stay at this location on the current observed fire activity and vegetation clearances and the support from the TFL. They expected to encounter a mild flanking fire in surface fuels to proceed toward their location from the end of Orchard Lane to the north.

- The only other fire activity in the general area was their firing operation in the buffer zone below the driveway and the probability that the CDF Fire Captain, seen near the garage by Captain McDonald, had also conducted some firing in that area.

- About 50 minutes after they arrived at 920 Orchard Lane, about 12:45 hours, the crew observed increases in fire intensity below them in the chaparral fuels. Shortly thereafter, around 1:00 p.m. the crew observed a rapid increase in fire activity which includes:

  - Rapid rise in ambient air temperature
  - Sudden increase in fire intensity from the ridgeline south of 920 Orchard Lane. There was no previous indication of any fire in this area.
  - Blowing embers
  - Decreased visibility due to increased smoke production
  - Flame front coming from the drainage laying over the driveway, first to the north of the engine and then immediately to the south of the engine

- Up until the last few moments the fire behaved as expected and predicted by the crew of Engine 6162. The firing operations, mentioned in the CDF Green Sheet, un anticipated wind shifts and gusts may have had an adverse impact on fire behavior that was predicted by the crew of Engine 6162 . The final moments of fire behavior did not match the crew's predictions or expectations.

Post Incident Considerations

- The converging factors, known and unknown, should combine to provide the crew with a "Situational Awareness" that will influence their decision to defend or not defend a structure. The known is what is observed and personally experienced and the unknown are those factors that are critical to the situation but are not readily available, obvious or explainable.

- There were several lateral drainages ran from the bottom of the San Diego River Drainage to the top of the Orchard Lane ridge line. These drainages were generally obscured by the height of the fuel, smoke drift and the increase in slope further down the western aspect. Drainages can potentially effect fire behavior however, it is unknown the extent to which they influenced the incident at 920 Orchard Lane.

- Firing operations must always be coordinated with adjoining resources and should never be attempted unless their safety can be verified.

- The ability to recognize the potential of fire behavior changes as a result of changes in fuel, weather and topography is crucial to crew safety. Information on specific areas of concern relating to drought, bug kill and other unusual conditions that may lead to extreme fire behavior should be shared on a state wide basis.

- A method, including "check backs", should be developed to advise crews on the line of the issuances of fire weather watches and warnings.

- See additional comments regarding using technology in the Post Incident Considerations in the Equipment section of Lessons Learned.

Lessons Learned
Personal Protective Equipment

Pre Incident

- The Novato Fire District issues all personnel a full complement of Personal Protective Equipment (PPE) including fire shelters and gloves. Personnel are required to purchase their own wildland boots. **All** PPE must meet the current CAL OSHA regulations, NFPA standards, and Novato Fire Protection District policy 1-V-12.

- Wildland PPE:

- Undergarments:
  - Nomex IIIA station uniform pants
  - Long sleeve 100% cotton T-shirt, gray in color, with District approved logo on front only
- Outerwear:
  - Wildland helmet with front brim, and adjustable leather/nylon chin strap
  - Goggles, with protective nose shield with ¾" elastic strap or 1/16" elastic cord retainer
  - Helmet shroud, attached to helmet with Velcro, and closed in front facial midline with Velcro
  - Protective structure hood (fire resistive) Nomex IIIA
  - Wildland jacket with single layer sleeves, Nomex IIIA with 6"x10" Nomex "Novato Fire Dist" patch on back
  - Wildland pants, single layer, Nomex IIIA
  - Structure or wildland leather gloves with wristlet
  - Protective full leather upper boots with lug soles

- Accessories
  - Current generation nylon FSS web belt with shoulder harness and pouches made of Cordura duck nylon cloth with polyurethane coating
  - Pouch with current generation nylon FSS fire shelter, GSA issue, California OES modification compliant
  - Pouch with Timberline hose clamp
  - Pouch with 2 plastic 500 ml commercially bottled waters
  - Pouch with hose fittings, such as 1.5" x 1.5" gated wye, 1.5" 20/60 KK forestry wildland nozzle, 1.5" spanner
  - Pouch with fusees (stored on apparatus) may be attached to web belt as needed
  - Portable radio Cordura nylon chest harness with Cordura nylon straps and heat resistant plastic buckles

- Exact brands may vary, however, all Wildland PPE must meet above stated standards.
- All personnel are provided with ongoing training in the donning of PPE, shelter deployment and PPE inspection practices consistent with NFD Basic Competencies, "Wildland PPE" and policies. (Appendix I).

Incident

- At the time the crew of Engine 6162 was operating at 920 Orchard Lane, all personnel were wearing the full complement of Wildland PPE as stated above, and in accordance with District standards.

- Captain McDonald and Engineer Rucker wore Nomex facial protection style masks. FF/PM Smith and Engineer Kreps had their structure hoods pulled up an in place. Captain McDonald's structure hood was pulled down around his neck. It is unknown if Engineer Rucker structure hood was pulled up and in place or down around his neck. Bandannas were worn by crew members, but not as facial protection.

- As a result of the burnover, the following observations on PPE and Equipment were noted:

  - All undergarments performed to specifications and expectations based on the specific conditions encountered, except: Captain McDonald's long sleeve T- shirt showed incipient signs of thermal degradation above the belt line on the back.

  - All outer garments performed to specifications and expectations based on the specific conditions encountered, except: Captain McDonald's 1/16" goggle restraint (round cord) failed due to intense heat.

  - Captain McDonald and Engineer Kreps received facial burns in the area expected to be protected by their Nomex helmet shrouds and the nose shields on their goggles.

  - FF/PM Smith received circumferential first degree burns around his eyes even though he was wearing his goggles.

  - Captain McDonald's wildland jacket was substantially thermally degraded on the back. Specifically, Captain McDonald sustained 2nd degree burns on his mid back in the pattern of the cross strap of the shoulder harness portion of the web belt.

  - Engineer Kreps sustained small 1st and 2nd degree burns on either side of his spine in the area of the cross strap of the shoulder harness portion of the web belt.

  - Captain McDonald's wildland pants were substantially thermally degraded on the back and the front at the knee level.

- Captain McDonald's was wearing single layer wildland gloves with wristlets. He sustained 2nd and 3rd degree burns to both hands.

- Captain McDonald's Cordura nylon radio chest harness and buckles were thermally degraded.

- Captain McDonald's web belt and shoulder harness burned while being worn due entirely to the high ambient heat. This resulted in the loss of all of his web belt equipment and transfer burns to his body.

Post Incident Considerations

- When considering any changes to wildland PPE it is important to remember that the Cedar incident was, in fact, a firestorm and not a normal typical wildland incident. During normal wildland operations the PPE required by OSHA, if worn as intended will work as it is designed to. This equipment is not necessarily designed to endure a firestorm where ambient temperatures can become extreme but survivable. A balance needs to be obtained between all gear for the "normal" and "catastrophic" situations that a firefighter may face.

- Web belts are an essential part of the PPE ensemble, allowing personnel to carry fire shelters, water, and other essential firefighting equipment. The typical web belt is constructed of nylon, an inherently combustible material, and plastic buckles likely to cause convective heat transfer to the wearer.

- Another inherent problem with web belts is that the shoulder straps compress the air space between the protective Nomex of the wildland jacket and the skin of the wearer. When this air space is compressed heat will more readily transfer through almost any protective material to the wearer. A reduction in the weight of the loaded web belt may reduce the compression situation or possibly allow the shoulder straps to be eliminated.

- This is an example of achieving a balance between normal and catastrophic operations. Heavy Nylon web belts work fine during normal operations but can exacerbate injuries and burns during catastrophic operations. Decisions to change construction materials should be based on seeking a balance somewhere in the middle between adequate protection and overprotection, cost vs. benefit.

- General wildland survival philosophy states that when using an escape route, to seek refuse to a safety zone, in a burn over situation firefighters should quickly shed all non-essential equipment including web belts. This procedure should be done while retaining portable radios and fire shelters. Based on the rapid sequence of events that occurred at the Cedar Incident this procedure does not seem to be a realistic expectation. Further research should be conducted in an effort to reduce

the weight and composition of the web gear so that it does not impair progress or cause burns to the wearer, so that it does not have to be removed in an emergency.

- Undergarments performed appropriately to provide a second layer of protection and minimized thermal skin burns. Captain McDonald suffered burns through his wildland jacket and T-shirt due to the ambient heat conditions and the burning web belt. Captain McDonald received burns through his wildland pants and Nomex station uniform pants in areas where his skin was in direct contact with the material and where the air space between the fabric layers was compressed. The burns on Captain McDonald's legs stopped at his lower underwear line. The triple layer of Nomex wildland pants, Nomex work pants and cotton underwear eliminated any burns in the groin area. It is likely that nylon or other synthetic undergarments would have caused the same burns as those that resulted from the combustibility of the web belt material.

- The 1/16" goggle restraint cord worn by Captain McDonald was not of sufficient dimension to withstand the ambient heat conditions. The ¾" goggle strap worn by other personnel did not fail. The District has seen a reduction in thermal injuries to the nose since personnel began wearing goggles equipped with nose shield.

- When helmet shrouds were worn in conjunction with structure hoods facial burns were negated.

- Nylon chin straps should be replaced with non combustible versions.

- While not causal to the injuries sustained at the Cedar Incident it should be understood that shrouds which seal along the midline of the face and are attached to the helmet with Velcro may not provide the most optimal protection currently available.

- Current District practice regarding the wearing of structure hoods, as a second layer of facial protection, on wildland fires allows for personal judgment. Captain McDonald had his Nomex face shield on at the time of maximum heat exposure. In this case the practice of allowing personal judgment may have resulted in some facial burns to Captain McDonald; however, his use of a personal Nomex facial protection style mask may have prevented more significant inhalation burns.

- Additional research needs to be conducted with a focus on protecting the wildland firefighter's airway in high ambient temperature situations. Captain McDonald, as did other civilian burn victims, incurred a lung infection due to exposure of organic spores that were present in the smoke. Apparently the filtering system in the personal Nomex facial protection mask he was wearing was not able to eliminate the exposure to these spores.

- While exposed to extreme heat the protection provided by the double layering of undergarments and Nomex outer garments did not fail. They provided the

expected level of protection even though the Nomex outer garments degraded to varying degrees.

- The wildland leather gloves did not provide protection against thermal burns when exposed high ambient temperatures resulting in 2nd and 3rd degree burns to Captain McDonald's hands. The burn demarcation line on Captain McDonald's hands occurred at the wrist line in the area in which double layering of the undergarments and the glove wristlets was maintained. In addition Engineer Kreps sustained first degree burns to his knuckles while using the same issued wildland gloves. It was not the material of the glove that caused the burns but rather its single layer construction and relatively tight fight that caused the burns. A second layer such as a non-combustible liner may provide the protection necessary to prevent similar injuries.

- Protective full leather upper boots with lug soles performed as expected.

- The current generation nylon and Cordura duck nylon cloth with polyurethane coating FSS web belt, pouches and shoulder straps worn by Captain McDonald burned and failed. The failure was due to its materials being inherently combustible with failure occurring at approximately 350 degrees F according to non-scientific studies. The burning web belt and components added to the degradation of the outer garments resulting in 2nd degree burns to Captain McDonald's back. These failures could cause the loss of vital safety, survival and communications equipment.

- Firefighters should never wear essential equipment made of inherently combustible materials while engaged in fire suppression activities nor should they wear any non-essential inherently combustible materials that can not be quickly and safely discarded in the event of an emergency.

Lessons Learned
Training and Experience

Pre Incident

- The Novato Fire District and the Novato Professional Firefighter's Association have collaborated on the development and implementation of an extensive Career Development Program. The Career Development Program models both the National Wildfire Coordinating Group (NWCG) and the California State Fire Marshal Training Guidelines (CFSTES) for all Safety Positions within the Organization. Personnel must meet the Career Development requirements prior to testing for a specific position.

- In addition to Career Development guidelines, the District has developed Standard Company Evolutions and proficiency standards for wildland operations. Standards are used to evaluate a company's performance and competency.

- According to District policy all engines are staffed with a minimum of a Company Officer (Captain), Engineer (Apparatus Driver/Pump Operator) and a Firefighter or Firefighter/Paramedic.

- Crews received field training in shelter deployment but not in re-locating to a safety zone or entering an engine in a crisis situation.

- Career Development minimum requirements specific to wildland firefighting include:

Captain

S-130, Firefighter Training
S-131, Advanced Firefighter Training
S-190, Introduction to Wildland Fire Behavior
ICS 200, Introduction to ICS
S-205 (S-215), Fire Operations in the Urban Interface
S-234, Ignition Operations
S-270, Basic Air Operations
S-290, Intermediate Fire Behavior
ICS 300, Intermediate ICS
S-212, Wildfire Power Saws

Engineer, Firefighter and Firefighter/Paramedic

S-130, Firefighter Training
S-131, Advanced Firefighter Training
S-190, Introduction to Wildland Fire Behavior
ICS 200, Introduction to ICS
S-212, Wildfire Power Saws

- In preparation for the advent of CICCS (the California adopted version of NWCG 310-1, Wildland Fire and Prescribed Fire Qualifications System Guide) the District has continued to add requirements, specific to wildland firefighting, to its Career Development Program.

- All four members of Engine 6162 exceeded the wildland specific training and experience requirements, for their respective positions, according to the Districts Career Development Guide.

- All four members of Engine 6162 also met or exceeded the education requirements of NWCG 310-1 for their respective positions.

- District personnel respond to several wildland fire incidents each year within the 71 square miles of the District. The District is located within six miles of the California coast, slightly north of the San Francisco Bay waters and over 40 square miles of the District is considered urban interface area.

- The typical weather pattern of the District includes a light morning sea breeze transitioning to a stronger afternoon westerly wind that surfaces at approximately 1400 hours. The rare north or east wind events produce high temperatures, low relative humidity but generally little surface-level wind. Interestingly, few fires have occurred in this period. The District has long believed that the recurrence of the typical weather pattern in the days immediately following a north/east wind event yield conditions that are most likely to result in a large-loss/acreage fire. Typical relative humidity in the summer months ranges in mid-thirties and temperatures from the mid-seventies to eighties.

- Fires occur predominantly in the urban interface area. Fires typically occur in fuel models of annual grass and Oak woodland. An occasional fire becomes established in heavier fuels such as brush (e.g., Manzanita). Because fires typically occur in the District interface (recent fire history has included fires of significant magnitude that caused loss of structures), personnel are extremely familiar with structure protection operations in this environment.

Incident

- The crew of Engine 6162 used their training and experience in the specific operations that were conducted at 920 Orchard Lane to:

- Initiate a standard structure protection evolution in accordance with the Districts Standard Evolution Manual and guidelines outlined in S-205 with the following exceptions:

    i. Entry was not made into the house therefore no interior preparation was completed.
    ii. The residential propane tank, located behind the house, was not shut off at the tank.
    iii. A secondary water supply was not available because the power needed to operate the pump on the well was out in the area.

- Remove light grass fuels, using drip torches and fusees, to create a defensible space below the structure using principles outlined in S-234.

- Identify an Escape Route and Safety Zone using the principles outlined in situational awareness training with LCES (Lookouts, Communications, Escape Routes and Safety Zones). Engineer Rucker was given the assignment of being the Lookout by Captain McDonald. All members did have a view of the surrounding area with the exception of the area to the south/southwest. Communications was confirmed and maintained with the Strike Team Leader.

- Remove brush and other similar fuels, with a chainsaw, from the driveway and adjacent areas as outlined in S-212 and S-205.

- Wear protective clothing and equipment in accordance with District policy, industry standards and S-130.

- Communicate amongst other Strike Team Resources and the Strike Team Leader as outlined in ICS-200 and 300.

- To identify specific triggers when the crew would access the escape route and safety zone. The collective experience and training of the crew prevented further injury or fatalities.

- Personnel are taught to discard non-essential tools and equipment when seeking access to a Safety Zone or Last Resort Survival Options. However, these behaviors have not been consistently reinforced by the District during training activities. If, in fact, Engineer Rucker was wearing a hose pack as indicated in the CDF "Green Sheet" it is unknown why he did not discard that pack. None of the other crew members can recall Engineer Rucker having a hose pack on his back during the operations at 920 Orchard Lane.

- Although personnel were several hundred miles from home, they were somewhat experienced with the fuel, weather and interface conditions presented on Orchard Lane. However, it should be noted they were unfamiliar and not briefed on the burning characteristics, fire history, micro-climactic and drought-stressed conditions or made aware of a "Fire Weather Watch" that had been posted on October 29, 2003 at 0900 hours.

Post Incident Considerations

- Once the decision had been made to commit to protect the structure at 920 Orchard Lane it is evident that the crew's training, experience and use of LCES saved the lives of three crew members when the fire unexpectedly blew up.

- Accurate and easily accessible training records proved to be a necessity in the Post Incident Evaluation of the crew's educational background including the OSHA review. These records also allow the District to periodically assess the currency of training for all members.

- Wildland safety and survival techniques should be incorporated into drill scenarios so that crews gain experience and are evaluated on their ability to Establish Lookouts, Establish Communication Procedures, identify and utilize Escape Routes, Safety Zones and Last Resort Survival Options.

- **No plan** to protect a structure should be based on the anticipated need to seek refuge in the engine, structure, or in a fire shelter when the flame front passes. On the other hand even the best managed events can change for the worse. In these cases last resort survival options such as entering the engine, structure, shelter deployment or any combination of these options should be identified early, re-assessed regularly and shared with all crew members. Time and the ability to select a combination of Last Resort Survival Options are the critical components to survival in the event of an interface burnover.

- The training received in S-205 (S-215) drove District philosophy regarding structure protection operations. In this case, the training received in S-205 and similar courses focus upon the ability to save the structure as opposed to the safety and survivability of the crew and the engine.

- A goal of future policy development and training is that an assessment of structure protection options should be primarily based upon the safety and survivability of the crew and engine with the structure as a secondary concern.

- A review of "Situational Awareness" is a key component in the assessment of any wildland firefighting scenario. "Situational Awareness" is the identification and mitigation options of the incident environment, resources and existing operations that affect the safety and survivability of the crew. The key to "Situational

Awareness" is to continue to communicate safety concerns to all crew members and to ask questions regardless of position or rank.

- It is also crucial that departmental training is based on strong organizational philosophy with supporting policies that provide members with mitigation options that are irrefutable up to and including refusal of assignments.

- It is critical that there be mutually agreed philosophy and supporting policy between federal, state and local agencies regarding wildland firefighting operations. Philosophy and supporting policy drive training and the formation of training curriculum. Training should not drive philosophy and policy.

- External training can inadvertently drive internal organizational philosophy. It is important that organizations evaluate the content of external training to determine if it meets their internal philosophy and policy.

- Experience and education based guidelines should be in place before allowing any member to accept an out of county assignment

Lessons Learned
Policy and Tactics

Pre Incident

The Novato Fire District had created several wildland firefighting standard operating procedures (SOPs), including the use of Personal Protective Equipment (PPE) and use of the Incident Command System (ICS); however, no specific SOPs existed relating to structure protection, firing or turning down assignments.

The District had developed a Standard Evolution Manual, Tactical and Task level standards, based on state and nationally recognized training curriculum relating to structure protection operations.

No internal process had been utilized to compare established state and national training curriculum with the experience of the members of the District in order to develop internal standard operating procedures in the areas of structure protection, firing or turning down assignments.

Incident

The crew of E6162 followed a standard structure protection evolution in accordance with the Districts Standard Evolution Manual and state and nationally recognized training curriculum in the operations that were conducted at 920 Orchard Lane by:

- Removing light grass fuels, using drip torches and fusees, to create a defensible space below the structure
- Identifying an Escape Route and Safety Zone using the principles LCES (Lookouts, Communications, Escape Routes and Safety Zones)
- Observed flame lengths in the brush were 25’ to 30’. Safety Zone standards denote a radius (from the center of the Safety Zone) of four (4) times the flame length for entire circumference of the Safety Zone. In this case the distance from Engine 6162 to the unburned brush below (west) was over 140’. This distance was much further than the 100’ to 120’ required for a Safety Zone. The distance to the unburned fuels to the south was approximately 100’.
- Assigning a Lookout (Engineer Rucker)
- Maintaining communications between the crew and confirming and maintaining communications with the Task Force Leader both face to face and via radio on established incident frequencies
- Wearing protective clothing and equipment in accordance with District policy and industry standards

- Identifying specific triggers when the crew would use the escape route to access the safety zone and when to seek refuge in the shelter. The collective experience and training of the crew prevented further injury or fatalities

- Developing a plan collectively, discussing the plan, thinking clearly, calmly and acting decisively when the situation deteriorated.

Post Incident

It is critical that there be mutually agreed philosophy and supporting policy or standard operating procedures between federal, state and local agencies regarding wildland firefighting operations with a focus on firefighter safety and survival. Philosophy derived from experience should be used to develop policy or standard operating procedures which should in turn drive training and the formation of training curriculum. Training curriculum should not drive organizational philosophy or policy.

It is also crucial that department members are supported by validated policies or standard operating procedures that are based on firefighter safety and provide all members with mitigation options that are irrefutable up to and including refusal of assignments.

In no case should policy impede firefighter safety nor should the basic premise of firefighter safety be forgotten or neglected.

When reviewing whether Engine 6162 should have taken the assignment at 920 Orchard Lane the following observations can be made:

- There is no way to conclusively prove that any crew, regardless of experience or training, could have anticipated the outcome of this event due to the casual, contributing and circumstantial factors that combined to create burnover.

- Post incident evaluation indicates most experienced fire officers would have made the decision to protect the structure at 920 Orchard Lane.

- In addition to the Crew of Engine 6162, the TFL, other Engine Companies in the TF, the Division and Aircraft in the area described the fire as “backing” or “flanking” in the direction of the homes on Orchard Lane until just before the burn over occurred.

- These same resources were also protecting structures in the same area, with the same fuel type and conditions.

- In a structure protection operation parking an engine between the oncoming fire and the structure may result in the engine and crew

being trapped when the flame front passes as occurred at 920 Orchard Lane.

- The significance of this decision depends on the ability to accurately predict the intensity of the approaching fire and the capability to assure the survival of the engine without damage and the crew without injury.

- If adequate clearance exists or the fuel, weather, topography and fire behavior combine to allow a safe operation this tactic may be acceptable.

- A search for safer alternative should still be conducted to take advantage of the protection of a structure or other feature that will deflect heat from the on coming flame front and allowing for a safer operation.

Implementing a standard of basing all actions on worst case possibilities would simply prevent firefighting personnel from taking any action to suppress a wildland fire or protect a structure.

- A balance between worst case possibilities and operations that provide for the survivability of the engine without damage and crew without injury must be developed and memorialized in policies or standard operating procedures and reinforced in training.

The philosophy that, *"Every Firefighter Deserves a Round Trip Experience"* must become the motto of the fire service and the basis for policy, standard operating procedures, and training.

- In the wildland environment this means that no structure protection operation is worth risking firefighter injuries, near misses situations or fatalities nor are they worth sustaining damage to an engine.

- Even minor damage to an engine such as, melted lenses or bubbled paint should be considered a near miss and a close call for the crew.

No plan to protect a structure should be based on the anticipated need to seek refuge in the engine, structure or in a fire shelter when the flame front passes. On the other hand even the best managed events can change for the worse.

- In these cases last resort survival options should be developed and included in department policies, standard operating procedures and implemented in training in addition to LCES.

The following guidelines should become the basis for both policy and training curriculum development:

- Activities that present a significant risk to the safety of personnel shall be limited to situations where there is a potential to save endangered lives.

- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of personnel, and actions shall be taken to reduce/avoid these risks or change tactics.

- No risk to the safety of personnel shall be acceptable where there is no possibility to save lives or property.

Simply stated:

- We will risk our lives a lot, in a calculated manner, to save SAVABLE lives.

- We will risk our lives a little, in a calculated manner, to save SAVABLE property.

- We will not risk our lives at all for lives, property or the environment that are already Lost/Can Not Be Saved.

Lessons Learned
Human Factors

Pre Incident

- The Novato Fire District provided physicals for its members
  - Members under 40 receive physicals every two years
  - Members over 40 receive physicals annually
  - Physicals are typically provided by the member's primary physician

- Due to legal requirements the District is only provided with general information regarding member health and fitness i.e.:
  - Fit for Duty
  - Fit with Restrictions
  - Unfit for Duty

- All District fire stations are equipped with a full complement of exercise equipment
  - Treadmills
  - Elliptical Trainers
  - Weights
  - Members are generally provided time to work out each shift between 07:00 hrs and 09:30 hrs

- The District has been in the practice of conducting third party fitness evaluations for all members annually.
  - Fitness evaluations had not been conducted in Fiscal Year 2002-2003 due to issues with the third party evaluator

- Firefighters are expected to make appropriate decisions in stressful and occasionally life threatening situations
  - The District does not have program to develop critical thinking skills in stressful situations nor does it have a program to determine if members possess or lack this critical ability.

- Prior to responding to the Cedar Incident, the crew had just returned from a four day break.
  - They had received adequate rest and had not worked any overtime shifts
  - The shift, prior to dispatch, was relatively uneventful.

- The total combined fire service experience of the Crew of Engine 6162 was 55.5 years.
  - Captain McDonald had =19 years of firefighting experience, plus an additional 7 years experience as a paramedic. His experience included 17 years with Novato Fire and one year with Marin County Fire Department.

- Engineer Kreps had 16 years of firefighting experience and 15 years experience as a licensed paramedic. His experience included seven years with Novato Fire and one season with the CDF.

- Engineer Rucker had 12.5 years of firefighting experience and 15 years as a paramedic. His experience included 11 years with Novato fire and two seasons with CDF.

- Firefighter Paramedic Smith had 8 years of firefighting experience and 2 years experience as paramedic. His experience included one year with Novato Fire and three seasons with CDF.

Incident

- At the time of the incident the crew of Engine 6162 had all been cleared for regular duty, by their physicians, without restrictions.
    - Engineer Rucker had been issued a recent prescription for an inhaler, typically associated with Asthma.
    - The District was not aware of this prior to the incident
    - NIOSH preliminary investigations indicate there is no evidence that Asthma was a factor in the incident.

- It is unlikely that fitness was a factor in this case since it was a short distance that the crew had to travel to the safety of the structure.

- There are several potential explanations for the delayed reaction and subsequent response of Engineer Rucker when the order was given to move to the house.
    - Intake of extremely hot air or fire gases resulting in breathing or respiratory issues
    - Tripping over hose lines or equipment located in the general area
    - An unidentified medical condition
    - A combination of the above

- There is no definitive proof that any of these factors contributed to the situation.

- It should be noted that all four crew members were in the same general area at the time of the burnover and were exposed to the same general environmental conditions.

- Engineer Kreps, standing closest to Engineer Rucker, was forced to cover his mouth with his gloved hand and take shallow breaths due to the intense heat.

- All crew members felt that they had received adequate rest prior to the incident.

- The collective experience of the crew and their ability to remain calm, think clearly, and respond according to an established plan was paramount in the survival of three members.

Post Incident

- In September of 2003 the District implemented the IAFF/IAFC Joint Labor Management, Wellness-Fitness Initiative.
  - All members now receive annual physicals by a designated District physician.
  - Peer fitness testing will be conducted internally and shared with the designated District physician

- District members are now required to pass a the Pack Test in order to participate in "Out of County Assignments"
  - A annual mandatory physical agility testing is being considered for all safety members

- As it relates to asthma and firefighters, the 2003 edition of NFPA 1582, Comprehensive Occupational Medical Program for Fire Departments states:
  - Asthma compromises a member's ability to safely perform essential job tasks
  - Acute hyper-reactivity on the fire ground environment can induce immediate or progressive clinical asthma (bronchospasm and wheeze) that can lead to sudden incapacitation from status asthmaticus and/or cardiac ischemia
  - Certain types of asthma now prevent individuals from being hired because it can inhibit the performance of essential job functions

- The military and the aviation industry have developed methods to analyze their members ability to think clearly and act decisively in stressful situations
  - This factor has been identified as a causal factor in other firefighter fatalities
  - The fire service needs to implement similar methods in an effort to prevent injuries and fatalities in emergency situations
  - Testing for the predictors of dangerous traits should also occur at the entry level and for those already working on the line
  - Methods to improve members performance in stressful situations, through training, must be developed

Title: Wildland Structure Protection Standard Operating Procedure

Overview

Structure protection is a dangerous task often performed at the most intense segments of the fire. Due to the inherent dangers of wildland firefighting in general and structure protection specifically it is imperative that personnel maintain "Situational Awareness" and focus on personnel safety and survival at all times.

Situational Awareness is the process used to identify, comprehend, analyze and react to critical elements of information or events that may impact the crew's ability to carry out assignments safely.

Philosophy

The Novato Fire Districts philosophy is based on a simple premise, *"Every Firefighter Deserves a Round Trip Experience"*. It must be the motto of all members that no structure protection operation is worth risking firefighter injuries, near misses or fatalities.

Structure protection operations are not worth sustaining damage to an engine. Even minor damage to an engine such as, melted lenses or bubbled paint should be considered a near miss, a close call for the crew and investigated as such.

Every structure protection operation must be based on a Situational Awareness and Structure Protection Assessment, and the development of Structure Protection, Safety, Survival and Mop Up Plans.

There may be times when it becomes necessary to turn down an assignment for fear of sustaining firefighter injuries, a potential near miss situation or possible fatality(s). In these situations the individual in charge should follow the District Refusing Risk SOP to the extent possible but without further risking the safety of the crew or engine.

Procedures

Situational Awareness Assessments must be based on:

- Information, events, decisions, orders or actions beginning prior to dispatch and continuing until the crew and engine are safely back in quarters, that may immediately or eventually affect the safety and survivability of the crew and engine

- Communication including questioning each other to increase the Situational Awareness of all crew members

Structure Protection Assessments must be based on:

- The survivability and safety of the crew and the engine
- Actions the homeowner has taken to create an adequate defensible space, non-pyrophytic landscaping and fire resistive construction
- Standard Structure Protection Assessment guidelines
- The potential for changes in weather and fire behavior
- Never accepting or settling for a bad situation
- The fact that what works at home may not work elsewhere in the State and conversely conditions experienced elsewhere can occur at home.

Structure Protection Plans must be based on:

The crew's ability to identify, in the Situational Awareness and Structural Assessments, the cumulative circumstances that conspire to create hazardous situations and their ability to eliminate the hazards or change tactics in time to make the situation safe for themselves and their engine including:

- The ability of the crew and engine to safely survive the passage of the flame front without taking refuge in the engine, structure or deploying a fire shelter
- Establishing Trigger Points which cause an immediate re-assessment of the situation and potential changes in tactics
- Identifying safe alternative options such as prepping and leaving and/or returning after the flame front has passed
- The Standard Firefighting Orders, the Watch Out Situations and the Common Denominators of Fire Behavior on Tragedy Fires
- A physical or mental step back to assure that your actions appear to be in accordance with your plans, and always searching for a safer solution.

*If conditions exist to safely make a direct attack on the fire all Firefighter Safety and Survival guidelines will be followed.

Safety Plans must be based on:

The crew's ability to establish Lookouts, Communications, Escape Routes and Safety Zones (LCES). LCES must be established, re-assessed and revised as conditions change. As Safety Plans change they must be communicated to the

entire crew. In operation, LCES functions sequentially and is a self-triggering mechanism.

Lookouts

- Lookouts assess – and reassess – the fire environment and communicate to each firefighter threats to their safety. Firefighters use escape routes and move to safety zones when threats to safety occur.

- Lookouts should be trained to observe the wildland fire environment and to anticipate and recognize and communicate fire behavior changes.

- Lookouts should be positioned where both the hazard and the firefighters can be seen.

    - Terrain, cover, and fire size determine the number of lookouts needed; every firefighter has the authority and the responsibility to warn others of threats to safety.

    - Lookouts must be in a position to provide the working crews with sufficient warning so that they are able to reach their Safety Zone safely.

Communications

- Set up communications system - radio, voice, or both – by which the lookout warns firefighters promptly and clearly of an approaching threat.

- It is paramount that every firefighter receives the correct message in a timely manner.

Escape Routes

- Escape Routes must be verified by actually traversing the route and assessing the time it takes to reach the Safety Zone.

- Preservation of the homeowner's vegetation, fences, or other structural features that impede the crew's use of the Escape Route(s) should be of minimal concern to the crew and if need be, cleared or removed.

- Driveways or access roads must meet the requirements of an Escape Route if the Safety Zone is not near the structure.

Safety Zones

- A Safety Zone must be an area where survivability is possible without fire shelter deployment.

- The optimum Safety Zones is four times the maximum flame length, measured from the center of the Safety Zone to the nearest fuel on all four sides

- The optimum area of a Safety Zone may be reduced based on varying fuel types, topography and structures or other natural objects that will act as a heat barriers as the flame front passes

- Engines, structures and bodies of water should be considered last resort survival options not Safety Zones.

Last Resort Survival Plans must be based on:

The crew's ability to identify, verify, establish and communicate Last Resort Survival Options before an event occurs. Last Resort Survival Options must be re-assessed, revised and communicated to the entire crew as conditions change. In operation, Last Resort Survival Options should be self-triggering when conditions change and Safety Plans are no longer an option.

- In the event that Safety Plans fail the survivability of the crew must become the only priority.

- Last resort survival options include taking refuge in an engine, structure, fire shelter or body of water

- The most effective option or combination of options will vary according to the conditions present at the time of the event

Mop up Plans must be based on:

The crew's ability access a water supply, the degree to which the structure was exposed to the flame front, other available resources and the urgency to take on a new assignment.

- A thorough mop up of the area surrounding the structure for a minimum of 50' or as dictated by an assessment of the surrounding fuel models

- Checking and re-checking for potential ignitions sources in the interior and exterior of the structure

- Waiting for a sufficient period of time to determine if re-ignition will occur

Summary

No plan to protect a structure should be based on the anticipated need to seek refuge in the engine, structure or in a fire shelter when the flame front passes. On the other hand even the best managed events can change for the worse. In these cases last resort survival options such as entering the engine, structure, shelter deployment body of water, or any combination of these options should be identified early, re-assessed regularly and shared with all crew members.

In no case should policy impede firefighter safety nor should the basic premise of firefighter safety be forgotten or neglected.

- Activities that present a significant risk to the safety of personnel shall be limited to situations where there is a potential to save endangered lives.

- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of personnel, and actions shall be taken to reduce/avoid these risks or change tactics.

- No risk to the safety of personnel shall be acceptable where there is no possibility to save lives or property.

Simply stated:

- We Will risk our lives a lot, in a calculated manner, to save SAVABLE lives.

- We Will risk our lives a little, in a calculated manner, to save SAVABLE property.

- We Will Not risk our lives at all for lives, property or the environment that are already Lost/Cannot Be Saved.

Title: Risk Refusal Standard Operating Procedure

Overview

The Novato Fire Protection District is an all risk organization responsible for responding to and mitigating medical emergencies, vehicle accidents, hazardous material releases, specialized rescue events, structure fires, vehicle fires, and wildland fires. As such we must recognize that there are both acceptable and un-acceptable risks to our personnel that come with this responsibility.

Philosophy

The Novato Fire District philosophy is that "Every Firefighter Deserves a Round Trip Experience". Therefore, every individual has the right and obligation to refuse an assignment, in accordance with this SOP, if that assignment is likely to result in injuries, near miss situations, or fatalities.

Procedure

A Risk Refusal is a situation where an individual having conducted a Risk and Situational Awareness Assessment determines that they cannot undertake the assignment because they deem it unsafe.

Assignments may be refused as unsafe when:

- There is a violation of safe work practices, District Policy, the Firefighting Orders, Watch Out Situations, LCES, etc.
- Environmental conditions make the work unsafe
- Crew members lack the necessary qualifications or experience
- Equipment is defective or unavailable
- The risk can not be mitigated and/or tactics cannot be changed
- An adequate Risk and Situational Awareness Assessment cannot be conducted

When an individual or person in charge chooses to refuse an assignment because they deem it unsafe, they must provide their immediate supervisor with the following information immediately:

- The reason for the for the Risk Refusal

- To the degree possible, safe alternatives for completing that assignment

The Supervisor who receives the Risk Refusal will make every effort to notify the Safety Officer. If there is no Safety Officer, notification will go to the appropriate Supervisor or to the Incident Commander. This assures accountability for decisions and communicates safety concerns to the entire incident organization.

If the Supervisor who receives the Risk Refusal asks another resource to perform the assignment, they are responsible for informing the new resource that the assignment has been refused and the reasons for that refusal.

If an unresolved safety hazard exists or an unsafe act was committed, the individual or person in charge should also document the Risk Refusal with a memo to their immediate Supervisor and/or the Safety Officer.

Summary:

These actions do not necessarily stop an operation from being carried out as long as the identified risk can be mitigated. This SOP is integral to the effective management of risk and the timely identification of hazards through the chain of command to promote firefighter safety and accountability.

In no case should policy impede firefighter safety nor should the basic premise of firefighter safety be forgotten or neglected.

- Activities that present a significant risk to the safety of personnel shall be limited to situations where there is a potential to save endangered lives.

- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of personnel, and actions shall be taken to reduce/avoid these risks or change tactics.

- No risk to the safety of personnel shall be acceptable where there is no possibility to save lives or property.

Simply stated:

- We Will risk our lives a lot, in a calculated manner, to save SAVABLE lives.

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- We Will Not risk our lives at all for lives, property or the environment that are already Lost/Cannot Be Saved.

Title: Wildland Firing Operations Standard Operating Procedures

Overview

Firing operations are often critical operations in the fire management job. If planned and executed correctly, they can speed control of a fire and greatly reduce suppression costs. Conversely, if not done right, they can endanger personnel, extend control time, damage property and increase cost.

Philosophy

Firing operations must not jeopardize the safety of personnel or equipment or invalidate suppression action on adjacent Divisions/Groups. Confirmation of this is absolutely mandatory prior to firing. No backfiring action regardless of strategic importance or other critical factors is worth risking one human life! When in doubt choose another safe and appropriate tactic.

Procedure

Backfiring

Backfiring operations are a method of indirect attack typically used against rapidly spreading fires. Safety considerations must be given first priority. Backfiring must be approved by the Incident Commander and should be performed by properly certified and qualified personnel.

The most successful backfiring is conducted from completed control lines. These are best located at a break in the terrain - the lee side of ridgetops is often best choice, canyon bottoms second choice and benches or roads in mid-slope third. The third choice is the most dangerous from the personnel safety standpoint and requires the most skill and understanding of fire behavior.

Backfiring is most often used to contain a rapidly spreading fire. Backfiring provides a wide defense perimeter, and may be further employed to change the force of the convection column. Backfiring is a tactic which makes possible a strategy of locating control lines at places where the fire can be fought safely on the firefighter's terms.

Except for rare circumstances meeting specified criteria, backfiring is executed on a command decision made through the ICS channels of authority. Occasionally a situation may develop requiring immediate action to backfire. Division/Group Supervisors, Initial Attack and Extended Attack Incident Commanders should be authorized to initiate backfiring provided:

- The act does not jeopardize the safety of personnel or invalidate the actions of adjacent resources and personnel.
- A change in weather or fire behavior requires this course of action to maintain control of the situation or control lines
- It is taken to mitigate a safety situation such as creating a safety or deployment zone

One Certified and Qualified individual must be responsible for controlling and directing the backfiring operation. If a qualified individual is not available the operation should not be attempted. In addition to Certified and Qualified individuals it is also necessary to have available:

- A sufficient number of skilled personnel assigned as a firing team
- A sufficient number of resources and personnel assigned to hold the firing operation

Burning Out

Typically Novato Fire District personnel are not certified and qualified to conduct firing operations; however, they may support a back firing operation by a certified and qualified individual or team, if needed.

A Burn Out operation is the intentional burning of fuels inside the control line to strengthen the line. Burning out is almost always done as a part of line construction (direct attack/parallel attack); the control line is considered incomplete unless there is no fuel between the fire and the line. Burn Out operations are typically performed without the approval of the Incident Commander or direct supervisor however, a notification of both is essential to avoid confusion regarding observed fire behavior on the incident.

Guidelines

The following guidelines apply to all firing operations and you must assure that you:

- Do not place fire fighting personnel or the public at risk
- Do not put property at risk
- Will be able to maintain control of the operation
- Will not make the situation worse
- Have a beginning point and an ending point (anchor points)
- Will be able to complete your operation with the personnel and equipment on hand
    - Do not start an operation that in order to complete you must rely on resources that are not on scene, they may never arrive
- Have considered all other options including the use of other tactics

- Will not delay suppression activities by spending the time to gather resources, prepare and execute the firing operation
- ***Coordinate with adjoining resources/personnel***

Conclusion

If you can not unequivocally make meet the guidelines of this SOP in the time available, do not fire!

THE INAJA FOREST FIRE DISASTER

Cleveland National Forest · California

"Surely these men gave their lives in defense of this country, for without the strength of our forests, water, and other natural resources, this Nation would not be a leader in the free world today."--Richard E. McArdle, Chief, Forest Service.

U. S. Department of Agriculture
Forest Service

Washington, D. C. January 1957

KILLED IN ACTION IN LINE OF DUTY

Overhead Personnel

Name & Age	*Fire Position*	*Regular Position*
Anderson, Albert W., 45	Night Sector Boss	Forest Service employee, Shasta-Trinity National Forest, Redding, Calif.
Lingo, Carlton Ray, 19	Night Crew Boss	Forest Service employee, Cleveland National Forest, San Diego, Calif.
Maxwell, Forrest B., 30	Night Crew Boss	Forest Service employee, Shasta-Trinity National Forest, Redding, Calif.
Wehrung, LeRoy, 41	Correctional Officer	Mechanic, Viejas Honor Camp, San Diego County, Calif.

Viejas Honor Camp Men

Daniels, Miles, 33	Fire fighter	Inmate
Fallin, Wm. D., 22	"	"
Garcia, George A., 41	"	"
Hamilton, Virgil L., 26	"	"
O'Hara, Joseph P., 45	"	"
Shepherd, Lonnie L., 26	"	"
Tibbitts, Joe, 34	"	"

The Inaja Forest Fire Disaster

(Pronounced Inn-ah-HAH)

November 25, 1956

Cleveland National Forest, California Region

Eleven men lost their lives in a fire blow-up in San Diego Canyon on the Inaja Fire, Cleveland National Forest, at 8:05 p.m., Sunday, November 25, 1956. Those killed included three Forest Service employees, a Correctional Officer, and seven inmates of San Diego County's Viejas Honor Camp. One Forest Service employee and six inmates escaped uninjured.

The Office of the Chief, Forest Service, U.S. Department of Agriculture, was notified at 3:00 a.m. (Midnight, Pacific Coast Time), as soon as the Cleveland National Forest and California Region had positively determined the general facts of the disaster.

Preliminary Investigation

Chief Richard E. McArdle immediately dispatched to the scene of the tragedy Merle S. Lowden, Chief of the Division of Fire Control, and Safety Officer Seth Jackson, both of the Washington Office, to gather pertinent detailed facts for the Chief's Office. They spent November 27 through December 3 with Forest Service Regional Fire Chief M. M. Nelson and other Regional, Forest, and Inaja Fire personnel studying the disaster area, interviewing and getting statements from those directly connected with the fire action or who might have pertinent information.

Investigative Team

Concurrent with sending the chief fire control officer and safety officer to the scene of the fire, the Chief of the Forest Service selected a top-level investigative team to go to the fire area. The team was headed by Assistant Chief of the Forest Service W. S. Swingler of Washington, D. C., and included Donald E. Clark, Regional Forester at Denver, Colorado; Lawrence K. Mays, Assistant Regional Forester at Atlanta, Georgia; Jack S. Barrows, Intermountain Experiment Station fire research chief, Missoula, Montana; and Mr. Lowden. Safety Officer Seth Jackson was designated as advisor.

In charging the investigative team with its responsibilities, Mr. McArdle said, "The scope of investigation should be directed to circumstances, events, and instances which led to the tragic loss of 11 fire fighters... we want facts, what happened, how and why. And we want these facts studied carefully and evaluated to formulate sound conclusions and recommendations--how could the final outcome, or any of the occurrences or situations leading up to it, have been avoided? Above all, include instances of carelessness or oversight that can be prevented in the future."

The investigative team assembled in San Diego, California, on December 3. It studied the accident scene on December 4, both from the air and on the ground. Interviews were arranged with the various officials, fire bosses, and fire fighters who were eyewitnesses to the disaster. These interviews, as in all previous investigations of disastrous fires, were originally scheduled in private in order to avoid unnecessary tension on the part of eyewitnesses. However, it became evident that the public interest in this particular fire disaster was so great that the interviews should be made public. Relatives and friends of the victims and the general public were invited to meet with the investigative team, and members of the press were present. Officials of both State and County agencies participated in the investigation. Upon completion of their investigation the team submitted their findings to the Chief of the Forest Service.

Origin of Fire

The Inaja Fire allegedly was set by a 16-year-old Indian, Gilbert Paipa, at his home on the Inaja Indian Reservation about 9:10 a.m., Saturday, November 24, 1956. He was apprehended by, and confessed to, Forest Service Investigator Elwood Stone, on Wednesday, November 28. Paipa said, "I just got a mad, crazy idea to do it. I threw a match in the grass to see if it would burn."

Initial Control Action

Two lookouts[1] reported the fire at 9:15 a.m. A three-man tanker crew arrived at 9:25. They could not control it. Acting Ranger John Davis recognized the fire's danger and dispatched additional men and equipment. By 5:00 p.m., the fire had crossed the San Diego River bed to the west, run over Mt. Gower and down the west side of El Capitan Reservoir and onto El Cajon Mountain. It had then burned an estimated 25,000 acres. In a meet-

[1] This and other technical terms in this report are explained in a glossary on the last page.

ing attended by Forest Supervisor Walter Puhn and officials of the California Division of Forestry, it was agreed that the State would handle all the fire west of the San Diego River except a portion on the north side of the fire between the river and Sawday truck trail. This latter division was across the river from Division IV, where the tragedy later occurred.

On the second day of the fire, the Forest Service had four fire fighting divisions led by experienced and qualified personnel from all parts of the California Region. Pine Hills Guard Station was fire headquarters. The flanks of the fire had been contained except for three hot sectors--a hand line from Eagle Peak down to the San Diego River on the south; across San Diego Canyon from rim to rim on the north; and across Cedar Creek at the rear of the fire. The latter was considered of greatest concern due to the threat to more than 100 homes nearby.

During the day, Sunday, the fire in San Diego River Canyon was advancing slowly up the canyon against the wind with occasional flareups. Tongues of flame intermittently moved ahead and up small side ridges. Fire on and just below the east rim of the canyon was quartering into the wind with occasional flareups as it reached heavy fuels.

High winds made it impossible to use helicopters until 4:00 p.m. The night line boss scouted Division IV on the north side and east of the San Diego River at 4:30 p.m. (An aerial photo-map of this area is shown on page 3.) Because of the wind, he had to fly high. This situation, coupled with the smoke from the fire, made it impossible for him to get complete information as to control lines lost and progress of construction of other lines. The fire edge was relatively hot, burning into the wind on the west side and more slowly on the east side.

Burning Conditions

Fire weather throughout southern California in 1956 was unusually severe. It was climaxed by a prolonged period of Santa Ana wind conditions[1] extending from November 19 through the Inaja fire disaster on November 25. The area was having unprecedented drought. Rainfall had been well below normal for 4 years.

During the afternoon and evening of November 25, relative humidity in the vicinity of the fire was near 18 percent and temperature was about 68°F. Gusty east and northeast winds averaging 15 or 20 miles per hour, but with some gusts up to 40 miles, were observed at many places around the fire.

Brush consisting of chamise and sagebrush of medium density covered much of the disaster area. Moisture content of the brush approximated the lowest ever measured for these species, and is believed to be near the minimum possible.

The San Diego River bed was dry. The canyon walls are steep and rugged, with slopes as steep as 70 percent in many places. Rock outcroppings are common on both sides of the canyon. The distance from the rim to the river bed was about 3,500 feet in the disaster area.

Day Shift Action, November 25

The job to be done on the east side of the San Diego River Canyon (Division IV, Sector G) was to clear by tractor a fire trail through the brush along the rim of the canyon and to construct by hand a similar trail from the top of the canyon rim to the dry river bed on the canyon floor. These trails were to serve as control lines for burning back to the main fire.

The tractor-built trail running along the rim was completed by 11:00 a.m. Some burning out to make the trail wider was started. The trail was patrolled by a 4-man crew, using a 280-gallon water tanker. Two attempts were made to start hand construction of the trail from the top of the rim to the canyon floor. In both cases the men were called back when it became evident that the trail could not be completed before being flanked by the main fire. Later in the day a third line was started. By 2:00 p.m. the crew had cut about 600 feet of fire trail downward from the canyon rim. It was estimated that 3 more hours of work were needed to reach the bottom. At about 3:00 p.m. the division boss withdrew the men from the third line because fire conditions seemed to make work there unsafe. The crew had completed nearly 1,100 feet of trail. The crew continued to patrol the tractor-built trail along the top rim of the canyon. Between 4:30 p.m. and 7:00 p.m. the fire quieted down. No flareups were observed during this period.

Night Shift Action, November 25

At the main camp the night shift division boss was instructed to build line and burn out. Since there was little specific information on Sector G available at the main camp because of the partial ineffectiveness of aerial reconnaissance, he was told to check with the day division boss for conditions on the ground.

[1] Strong, dry winds from the desert area east of the coast mountains flowing down through the mountain passes and canyons to the sea.

The night shift arrived at the fire after dark, about 7:00 p.m. The day division boss briefed the night division boss on fire conditions and work done during the day. He emphasized that during the day the wind had been tricky and that difficulty had been experienced along the rim when burning-out operations were attempted. The night division boss discussed the conditions with his two sector bosses, and they agreed upon a plan of action. One sector boss and one crew boss with 20 inmates were to burn out along the tractor-built line on the canyon rim and down the hand line. Operations of this kind are normally carried out at night when winds subside and burning conditions are less hazardous.

The second sector boss with 3 crew bosses, the correctional officer, and 13 inmates was to complete the cutting and scraping of the hand trail to the river. The two sector bosses synchronized their watches at 7:18 p.m. and agreed to have a radio check at 7:55 p.m.

The plan went into operation with men going down the hand line and the tanker crew on the rim laying a hose to help hold the burning-out fire. One length of hose broke and some water was lost in replacing it. The water in the tanker was used up by 8:00 p.m.

The brush cutters in the 13-man trail-building crew started work as soon as they reached the point where the day crew had stopped work. The scrapers waited a few minutes until the cutters got a short piece of trail cleared. The boss of these scrapers lined out his men and gave them instructions on the work they were to do. He then went back up the fire trail toward the canyon rim to check on the burning-out work as the sector boss had previously instructed him to do.

When the scraper crew boss got to the top of a small 15-foot bluff on the trail, approximately 75 feet in a direct line from the canyon rim, he noticed that the main fire was unexpectedly flaring up on a side ridge more than 1,000 feet below the men. Suddenly it made a short run toward the main ridge where the men were building trail. He called a warning to the men working on the fire trail below and told them to come out. One of the bosses below answered his warning.

The men stopped work and all started back up the trail at a normal pace. This was at about 7:45 p.m. The men farthest down the hill had approximately 1,100 feet to travel up the trail. Survivors reported that there was no panic. Some of the men wondered why they were being called out. Most of them kept their tools. One even picked up a shovel and canteen abandoned by another.

The fire below suddenly gathered momentum and the crew boss on the top of the small bluff saw that it was now a real threat to the men below. This happened about 2 minutes after the first warning and he again yelled to the men, telling them to hurry up. Most of the men now dropped their tools and began to go faster.

Two of the men stationed on the upper part of the line escaped before the fire reached the rim. Two others who also had been working on the upper part of the line stopped at a small open spot just below the rock bluff on the cleared line. Others pressed on up to them from below. Within a minute or two, 5 men who had been working lower on the line reached the 2 men waiting in the open spot. They were slightly ahead of the remaining 9 men. By this time the fire had outrun them to the right and had crossed the cleared trail above. These 5 men turned off to the left, climbed and struggled up the 15-foot rock bluff, and raced the remaining 75 feet to safety at 8:05 p.m. They reported later that on this last stretch the fire was only 10 feet behind them.

The 11 victims were cut off while still below the small bluff, presumably by an instantaneous "flash-over" of a large area of fire. This sudden expansion of the fire front was testified to by the survivors and other nearby observers. In addition, two fire bosses on the opposite side of the main San Diego Canyon observed the action of the fire when it made its fatal run. They reported that it ran up the ravine beside the ridge where the men were working and across the fire trail near the top. At about the time the fire got to the rim there was a sudden "flash-over" to the left, which the observers said simultaneously ignited a large area, perhaps 40 acres. This explosive "flash-over" enveloped the 11 victims just below the small bluff. It apparently was caused by ignition of gases forced up the ravine by the extremely rapid run of the fire.

All victims were found in an area with a radius of 45 feet and the lowermost one was only 300 feet from the tractor-built line at the top of the canyon rim. The fire barely crossed this line in only a few places, where it was quickly put out. Of the men that escaped, two had been working at the very lowest part of the trail. Two who had been working closest to the rim did not escape.

Several of the fire fighters, including the forest officers who lost their lives, stayed

with the crew until the last, helping and urging others out even though they might otherwise have had an opportunity to escape. One of those who escaped credited a fellow crew man with saving his life when he became exhausted while climbing over the rock bluff.

Control of the Fire

Before being controlled at 6:00 p.m., Wednesday, November 28, the fire burned 43,611 acres within the Cleveland National Forest and adjoining land protected by the State. The area burned had a 90-mile perimeter. At least 5 homes were destroyed. More than 2,000 men fought the fire, 1,300 under Forest Service supervision. These included 500 Indians (local and Southwestern Region), about 500 Navy personnel, 200 inmates from San Diego County and State Honor Camps, and other organized crews. These men plus 3 helicopters, 4 air tanker planes, 2 scouting planes, 27 bulldozers, and a fleet of 90 stake, tank, and pickup trucks, formed one of the greatest arrays of men and equipment ever assembled to fight a forest fire in San Diego County.

Conclusions

A. Fire behavior. The disastrous flareup of the Inaja fire was caused by a critical combination of highly flammable fuels, steep topography, and adverse weather. The lull in the fire before and at the time of arrival of the night crews created a false sense of security, even though existing conditions of fuel, topography, and weather were critical.

B. Crew location in canyon. The men were taken down the line into the canyon owing to a lack of information to show possible danger from the fire in the canyon below. The contributing factors were:

(a) Absence of specific information on the fire status in San Diego Canyon available for the briefing at the base camp, due to poor conditions for aerial reconnaissance.

(b) Emphasis placed on the danger of the burning-out fire rather than on the main fire in the canyon below, when the day division boss briefed the night overhead personnel.

(c) Quiet appearance of the fire as viewed from the rim.

(d) The night overhead personnel had not seen the terrain in daylight.

(e) Lack of detailed scouting of the canyon on sector G during the day.

(f) Absence of contact with the bosses of the division across the canyon who had a different vantage point for viewing the situation.

C. Trail location. The location of the fire trail on the specific ridge where it was built instead of the next spur ridge up the canyon was questionable. The previous behavior of the fire and the position above and alongside a precipitous chimney made the chosen location hazardous.

D. Burning-out. Sound fire fighting principles call for burning out the intervening fuels between the control line and the fire edge. The effect of the burning-out fire on the behavior of the main fire and on the planned escape routes is a vital factor influencing decisions on when, where, and how to burn out, and where to place men.

Fire behavior is not well enough understood to firmly establish the possible effect of the burning-out fire in sucking the main fire rapidly up the chimney at the site of the disaster. Other factors would have permitted the explosive run without the presence of the burning-out fire. Furthermore, the burning-out fire did not cut off the escape route.

E. Lookout. The crew cutting line into the canyon received warning to come out when a crew boss on the upper part of the line saw the fire heating up at a point below the men. It is uncertain in the Inaja fire disaster that a specifically designated lookout would have given the warning any sooner. However, it is vital that a lookout be designated when crews are in a potentially dangerous location.

F. Water. Exhausting the water supply from the tanker at the time of the flareup did not cause or contribute to the tragedy. The flames that raced up the canyon slope were of such height and were extended so far in advance of the burning fuel, that water available from one or several ground tankers would not have had a material effect.

G. Personnel. The leaders on the Inaja fire were capable and experienced. They were trained in accordance with recognized Forest Service standards. There is, however, need for more intensive advanced fire behavior training for key fire supervisory personnel.

Line crews on the sector where the tragedy occurred were experienced, trained fire fighters. Moreover, on this sector there were experienced overhead personnel from the local forest and from other forests.

Recommendations of the Investigating Team

A. It was strongly brought out by the investigation that better knowledge of fire behavior must be developed as an essential means of preventing future fire tragedies. Research studies even more comprehensive and penetrating than past and current fire

behavior research must be carried out to determine means of fighting mass fires and the behavior of fires in forested areas, especially in rough topography. In addition to progress in fire control methods already made, new and more powerful methods of attacking mass fires are needed and must be developed. Such methods, like use of aerial attack with water and chemicals, may provide the means of controlling dangerous fires with less risk to human lives.

B. More experts on fire behavior must be developed for assignment to critical fires. These highly skilled experts would evaluate situations and assist fire bosses in making decisions for safe, effective fire fighting.

C. The investigators pointed out that in general, although not related in particular to the Inaja fire, present Government salary and wage rates make it difficult to obtain and hold competent fire control personnel. Controlling mass forest fires is a difficult and highly technical job. The specifications for these positions should be further reviewed with appropriate Department and Civil Service Commission officials.

Working Notes and Data

The investigating team's voluminous notes, maps, photographs, analyses of weather records, fuel moisture measurements, fire behavior observations, information on training and experience of leaders, etc., are to be filed with the office copy of this report. Further study will be made of this material and a Service memorandum will be prepared covering points which may be helpful to Forest Service officials having fire control responsibilities.

GLOSSARY

Base camp.--Same as main camp, in this case. See Main camp.

Control line.--See Hand line.

Division.--A unit of a complex fire perimeter between designated topographical or cultural features (such as ridges, streams, and roads) organized into two or more sectors for control.

Fire trail.--Same as fireline. See Hand line.

Fire weather.--Weather factors that affect the probability that forest fires will start and their rate of spread after starting. It is the composite of elements such as drought conditions, wind, and air temperature and relative humidity.

Flanks of a fire.--The parts of a fire's perimeter that are roughly parallel to the main direction of its spread or progress.

Hand line.--A fireline or control line made with hand tools rather than machines such as bulldozers. A strip a few inches to several feet wide is scraped or dug to mineral soil so that fuel is absent and the fire's progress may be halted when it reaches the fireline. Sometimes a fireline is located some distance from the main fire and then the intervening vegetation and fuels are purposely burned to make a much wider strip devoid of fuel. This is called backfiring or burning out.

Lookout.--A person designated to detect and report forest fires, from a vantage point such as a tower or a natural elevation.

Main camp.--Headquarters of the fire boss, who is responsible for all suppression and service activities at a fire. Same as fire headquarters.

Sector.--A designated segment of fire perimeter or control line comprising the suppression work unit for two or more crews under one sector boss.

Tanker.--A truck equipped to carry water or other liquids used in suppressing a fire.

GPO 818940

Acknowledgements

The Board of Directors and members of the Novato Fire Protection District gratefully acknowledge the support received from all California Fire Agencies, the California Department of Forestry and Phoenix Fire Department, and Phoenix Fire Chief Alan Brunacini, during and after the Cedar Fire tragedy.

For coverage of Novato Fire Stations, we thank all of the Marin County Fire Agencies.

For assistance with the Memorial Service for Engineer Steven Rucker, we thank all of the Office of the Governor of California, Governor Elect Arnold Schwarzenegger in County Board of Supervisors, the Marin County Fire Department, Vallejo Fire Department, Marin County Sheriffs Office, Novato Police Department, California Highway Patrol, Marin County Department of Public Works, Marin County USAR Team, Marin County Administrators Office, Marin Center, California Office of Emergency Services, Skywalker Ranch, Golden Gate Transit, International Association of Firefighters, Keaton's Mortuary, Marin County Firefighters Local 1775, KPIX Television, and Valley Memorial Park.

For the immeasurable support, sympathy, and concern received from the community of Novato and around the world for all of us in the Novato Fire Family, we thank you.