CALIFORNIA (Updated February 2003)

I. INTRODUCTION

This section will examine some of the fuels, weather, and topography factors that you may be challenged with in Northern, Central, and Southern California. In order to identify the appropriate strategy (over-all plan), and tactics (deployment of resources to accomplish the plan), you must be able to recognize local fuels, weather, topography, and other special considerations specific to California.

II. NORTHERN CALIFORNIA

Northern California history of large fires is most often based on synoptic weather types producing high fire danger. The annual precipitation is generally light, around 10 to 20 inches at the lower elevations. Precipitation in the mountain ranges up to 60 inches or more. Summers are usually rainless, with persistent droughts common in most southern sections. Particularly important are the ridge-aloft patterns, which produce warm, dry weather, and the patterns producing high-level thunderstorms. Widespread summer thunderstorms with little precipitation reaching the ground, occasionally result in several hundred local lightning fires within a two or three day period. Large fires also occur with the passing of dry cold fronts, usually in late summer (from August on) and early fall. In June and July 2001, several large fires occurred resulting in several Type 1 teams being initiated. Notable fire years are 1920, 1934, 1960, 1967, 1984, 1987, 1994, 2000 and 2001. Extremely heavy fuel volumes result in long duration fires with extensive mop-up issues. Structure threats are becoming more common. These structure problems often exist in small communities where numerous houses and cabins can also be found isolated through an area. Northern California includes the Klamath, Six River, Shasta Trinity, Modoc, Mendocino, and Plumas National Forest and can overlap with the National Forest found in Central California. Logistical support can be a difficult challenge in many of the Northern California remote areas and spike camps are common on large fires. The California Department of Forestry (CDF) will be the biggest cooperator when involved with multi jurisdictional fires where Type 1 Teams should be prepared to enter into a unified command structure.

III. CENTRAL CALIFORNIA

Central California also has a history of large, damaging fires. For purposes of this class, Central California will include the Sequoia, Sierra, Inyo, Stanislaus, El Dorado, Tahoe, Tahoe Basin and Lassen Forests, Yosemite, and Sequoia Kings Canyon National Parks (Central Nevada Range). Low frequency, high intensity large fires are the historic pattern. This pattern can often be associated with drought conditions and lightning storms; however human caused ignitions have resulted in large damaging fires. Structural threats can be a protection problem, but somewhat different than Southern California. Southern California structures are often found densely packed at the base of foothills. Central California has some areas like this, however much of the problem consists of small communities tucked in the woods. Numerous houses and cabins can also be

found isolated throughout the area. Commercial timber, spotted owl habitat, archeological sites, wilderness area and other natural resources are often the protection priorities. Heavy fuels, burning intensely in remote areas, often characterize Central California wildfires. Logistical support can be a difficult challenge as these large fires often burn for extended periods.

IV. SOUTHERN CALIFORNIA

Southern California has a long history of large and damaging fires. Some of the more notable include the 1970 **LAGUNA** –182,000 acres, 1977 **MARBLE-CONE** -178,000 acres, 1980 **PANORAMA** -300 homes lost, the numerous fires in the fall of 1993 which burned over 250,000 acres and where over 1,000 homes were lost, 1999 **KIRK** -118,000 acres that burned for 3 months, most recently the 2002 **CURVE and WILLIAMS** - 2002-65 homes lost. Deaths to firefighters include: 1956 **INAJA** -11 fatalities, 1959 **DECKER** -7 fatalities, 1961 **LOOP**-12 fatalities, 1979 **SPANISH RANCH** - 4 fatalities, 1993 **GLEN ALLEN** - 2 fatalities, and 1999 **JOLLA** -1 fatality. Weather conditions, such as Santa Ana winds, and Sundowner winds cause adverse fire behavior and rates of spread under severe conditions that may reach 6,000 acres per hour. These fires are further complicated by high flammable fuel and steep topography.

An IMT, crew or individual resource must be constantly aware of structures within the wildland. Virtually any extended attack wildfire in which a Type 1 Team is assigned will involve a structure threat. During the fall of 1993, over 1,000 homes were destroyed between October 26 and November 4, through a series of fires in Southern California. Even relatively small fires such as the **SCYAMORE** fire (1977-less 1000 acres –245 homes lost) and the **PAINT** fire (1989-900 acres-641 homes lost) can present substantial structure protection problems. Whenever structures are threatened, numerous other agencies will most likely be involved and must be included in incident management operations. Specific suppression problems associated with structures in wildland fires is covered in a separate class.

For this section, Southern California will include San Diego, Riverside, San Bernardino, Orange, Los Angeles, Ventura, Kern, Santa Barbara, San Luis Obispo, and Monterey counties. This area involves the Santa Monica Mountains National Recreation Area, Angeles, Cleveland, San Bernardino, and Los Padres National Forests and Joshua Tree and Death Valley National Parks. The Sequoia, Sierra, Inyo, and Stanislaus National Forest can overlap into Southern California.

V. NORTHERN CALIFORNIA FUELS

The vegetation in the Northern California area consists of grass in the lowlands, brush at the intermediate levels, and extensive coniferous stands in the higher mountains. Mixed conifer fuels present the primary fire problem in Northern California.

A. Douglas-fir/Hardwood:

Douglas-fir/hardwood can be found from the 3000-foot elevation on up. Natural fuel loading is 3 to 33 tons per acre. Average duff depth is 2 inches. Wildfire can spread moderate to rapid in drought stricken areas with extensive down and dead.

B. Douglas-fir/Hemlock:

Douglas-fir/hemlock has a natural fuel loading of 14 to 33 tons per acre. Average duff depth is 2 inches. Fire spread can be as much as 10 chains per hour depending on fuel loading.

C. Lodgepole Pine:

Lodgepole pine can be found from the 3000-foot elevation on up. Natural fuel loading for lodgepole pine is 3 to 35 tons per acre. Average duff depth is 6 inches, which can cause extensive mop-up. Wildfire can spread rapidly with the down and dead fuels mixed in. Strong winds combined with ladder fuels can cause crown fires.

D. Ponderosa Pine:

Ponderosa pine can be found from 4000-7000 feet elevation. Natural fuel loading for ponderosa pine is 1 to 48 tons per acre. Average duff depth is 1.5 inches. Drought stricken areas can produce beetle kill and snags can be hazardous.

E. Subalpine Fir:

Natural fuel loading for subalpine fir is 3 to 36 tons per acre. Average duff depth is 4 inches.

F. Mixed conifer:

Mixed conifer can be found from approximately 3000 to 9000 feet elevation. It can range from 7 to 56 tons per acre and have average duff depths to 2 inches. A combination of young to moderate reproduction and mature conifers can provide ladder fuels to the crown of mature conifer. This can produce long range spotting.

G. Brush Fields:

Mixed brush can be found at the intermediate elevations. Natural fuel loading is 5 to 37 tons per acre. Average duff depth is 20 inches, which can create extensive mop-up. Most brush field is a result of old burns.

H. Oak-Madrone:

Not considered a fire threat unless extreme weather, fuel and topography exists.

VI. CENTRAL CALIFORNIA FUELS

The Central Sierra Range consists primary of grass and oak at the lower elevations, mixed brush at the intermediate levels and coniferous stands at the higher elevations. The eastern side of the Sierras is dryer and consists of sage transitioning into ponderosa and Jeffery pine at higher elevations. Mixed conifer fuels present the primary fire problem in the Central Sierra Range.

A. Oak woodland:

Oak and grasslands will be found at the lower elevations up to 2500 feet. These fuels occur primary on the west side of the Central Sierras. Oak grasslands are fire behavior fuel model 1; it is less than one ton per acre. Wildfire is carried through the fine grass fuels. Fire spreads rapidly and responds well to direct control efforts.

B. Mixed brush:

Mixed brush (chaparral, deer brush ceanothus and manzanita) can be found at the intermediate elevations on the west side of the Central Sierras. Mixed brush in the Central Sierras can often be accompanied by a timber overstory. Mixed brush exists between 2500 and 4000 feet. It is a combination of fire behavior fuel models 2 and 4; it ranges from 10 to 20 tons per acre. Wildfire can spread moderately through these fuels and can be very difficult to control.

C. Sage:

Sage can be found at the lower to intermediate elevations on the east side of the Central Sierras. Sage is fire behavior fuel model 2; it is less than one ton per acre. Sage can burn at a moderate rate of spread, but usually requires a moderate wind to spread. Sage has little continuity on the east side of the Sierra Range.

D. Mixed Conifer:

Mixed conifer can be found from approximately 4000 to 9000 feet elevation. Mixed conifer is fire behavior fuel model 10; it can range from 10 to 50 ton per acre. Duff layers (compressed pine needles and organic matter) can range from 2” to 6” in depth. Mixed conifer in the Central Sierra Range consists of Jeffery Pine, White Fir, Douglas Fir, Incense Cedar, Red Fir, White Pine and Ponderosa Pine. Mixed conifer fuels present the most difficult fire problem in the Central Sierra Nevada Range. The worst or most hazardous mixed conifer fuels is:

1. A combination of young to moderate reproduction and mature conifer. This provides ladder fuels to the crown of the mature conifer.

2. A combination of mixed conifer fuels combined with mixed brush understory. Once again, this provides a combination of ground and crown fuels.

3. Mixed conifer fuels when the 1000 hour fuel moistures dip down into the low teens. Fuels become explosive at this moisture content.

VII. SOUTHERN CALIFORNIA FUELS

A. Chaparral:

Southern California fuel is dominated by brush but includes large areas of oak woodland and some small stands of timber. The term chaparral is often used to describe these fuels. Chaparral communities are generally bounded by timber stands over grasslands below. Elevations where chaparral is found vary from about 500 to 5000 feet. Chaparral is well adapted to fire, and a fire every 20 to 30 years is necessary to keep it healthy. Chaparral is made up of relatively large amount of loosely arranged small material, much of it becoming dead as the plant matures, and it's highly volatile oil content make it extremely flammable. Burnable chaparral fuel will average 15 to 20 tons per acre but can range from 2 to 40 tons per acre. After a fire, the chaparral is relatively fire-resistant for about 15 years. At about 20 years of age, the proportion of dead fuels becomes great enough to support large fires under adverse conditions. As a consequence, the recurrence intervals of fires more than 5000 acres are 20 to 40 years. Most fires in chaparral, which exceed 30,000 acres, occur in age classes greater than 30 years. Chaparral is fire behavior Fuel Model 4.

1. Chamise and Manzanita - The Primary Components.

   Chamise is the most abundant and wide spread of all chaparral shrubs in Southern California. It usually occupies the drier, south facing slopes. Manzanita is the second most important group of shrubs and it usually occupies the moistest, north facing exposures. Chamise decreases in abundance with elevation and gives way to manzanita at the higher altitudes.

2. Other Chaparral Fuel Components

   Other specific fuels included in Southern California chaparral are buckwheat, sage (several types), scrub oak, and oak woodland sumac. There are many additional fuels; however, they don't match these in consequence.

B. Fuel Characteristics:

Grass in Southern California usually begins to burn in May. Normally, chaparral will start to burn and sustain fire in late June or early July. The fire season ends around the first of December. However, major fires have occurred in January, February, and March. Chaparral fuels are relatively drought resistant; live fuel moistures may drop to 60% during critical periods. Dead fuel ratios will range from 15 to 50%, depending on the age of the fuel.

C. Chaparral Communities in Other Regions:

Chaparral exists in numerous mediterranean areas throughout the world (South Africa, France, Australia, Spain, Mexico, and Chile). Chaparral is also found abundantly in Arizona. Arizona chaparral and California chaparral have common origins on the North America Continent. Arizona chaparral differs from California chaparral as follows:

1. Arizona chaparral has a higher portion of sprouting shrubs.

2. Most of Arizona chaparral is on rough broken terrain at elevations ranging from 3000 to 6000 foot elevations.

3. The upper elevations border ponderosa pine or pinyon juniper and the lower elevations border desert grassland or southern desert shrubs.

4. Arizona chaparral grows primarily during summer, whereas California chaparral grows primarily in the winter and spring.

5. The fire frequency in Arizona chaparral is somewhat less than California chaparral. Although we have identified some differences in California and Arizona chaparral, they both are dependent upon fire to remain healthy and behave very similarly under extreme fire conditions.

VIII. NORTHERN CALIFORNIA FIRE WEATHER

Winter temperatures are quite low and summer temperatures are moderate. Annual precipitation ranges from 10 to 20 inches in the valleys, to 40 to 60 inches or more in the mountains. Most of the precipitation falls in the winter and spring. Winter precipitation is in the form of snow. Summers are usually rainless, with persistent drought common in the most southern sections. Widespread thunderstorms, with little precipitation reaching the ground, particularly in the mountains of the northern half, occasionally results in several hundred local fires within a two or three day period. The fires season usually starts in June and lasts through September.

Several synoptic weather types produce high fire danger. One is the cold-front passage followed by winds from the northern quadrant. Another is the weather condition similar to the east-wind type of the Pacific Northwest coast, except that the high is farther south in the Great Basin. The Great Basin high type produces the Foehn-type mono winds along the west slopes of the Sierras and Coast Range.

High fire danger also occurs when a ridge or closed high aloft persists over the western portion of the United States. At the surface, this pattern produces very high temperatures, low humidities, and air mass instability. Extreme blow up conditions on fires often occur under this weather condition.

A. Gravity or Foehn Winds

A Foehn Wind is created by gravity. Typically, heavier air spills over high elevations and races downhill. This type of wind is sometimes referred to as a fall of foehn wind.

Foehn winds also occur when a high-pressure system is located in and around mountain ranges. The airflow around the high-pressure system causes some of the air to spill over the higher elevations, resulting in a strong wind racing downhill at a phenomenal rate of speed. This causes fuels to dry out. As the temperatures increases, wind speed may reach 50 to 70 MPH. Many of the largest fires have been caused by gravity of foehn winds.

North and mono winds in Northern and Central California develop as a high moves into the Great Basin. North winds develop if a high passes through Washington and Oregon.

B. Thermal Belts

In mountainous areas, the height of the top of night inversions, although it varies from night to night, is usually below the main ridges. The height of the warmest air temperatures at the inversion top can be found by measuring temperatures along the slope. From this level, the temperatures decrease as one goes farther up or down the slope. At this level are both the highest minimum temperatures and the least daily temperature variation of any level along the slope. Here also is the lowest nighttime relative humidity and the lowest nighttime fuel moisture. Because of these characteristics of the average level to the inversion top, it is known as the thermal belt. Within the thermal belt, wildfires can remain quite active during the night. Below the thermal belt, fires are cool, humid and stable air exists, often with downslope winds. Above the thermal belt, temperatures decrease with height. Thermal belts are common through the Geographic Area.

IX. CENTRAL CALIFORNIA FIRE WEATHER

The annual rainfall averages 10 to 20 inches at the lower elevations and from 30 to 40 inches at the upper elevations. From July to September, rainfall is minimal. Most large fires occur between late July and late October.

A. Temperatures:

Temperatures at the lower elevations range from the mid 70's to the mid 90's. Temperatures can exceed 100 degrees under extreme conditions. At the higher elevations (above 6000 feet), temperatures range from the high 60's to the low 80's. Temperatures can drop below freezing at night at higher elevations.

B. Humidities:

Humidities can range from the mid 20's to the high 30's under normal conditions. Humidities can drop to the low teens during extreme conditions.

C. Winds:

Average winds range from 7 to 10 MPH out of the south-southwest under normal conditions. A frontal wind (in conjunction with the passage of a weather front) can create wind speeds in excess of 30 MPH.

D. Special Weather Conditions:

1. The most common special weather conditions are thunderstorms. Thunderstorms are a source of fire ignitions and cause erratic winds from unpredictable directions.

2. Another special weather condition is "mono" or east winds. These gravity winds are usually associated with a high-pressure system moving southeast across Washington and Oregon from the Gulf of Alaska. Humidities drop, temperatures rise and winds can blow in excess of 30 MPH. These conditions occur most often in spring and late fall. A wildfire under these conditions, particularly in fall, can be very intense and difficult to control.

X. SOUTHERN CALIFORNIA WEATHER

Annual rainfall in Southern California varies depending on elevation, from 10 to 40 inches a year. From May until December, Southern California receives little to no rainfall. Fuels at the lower elevations such as grass, light brush and desert fuels will burn early in the season. As the heavier brush dries out, depending on rainfall and weather, it will start to burn in June. A dry winter will cause an early season in heavy fuels, but will reduce starts, spotting, and rates of spread due to less flashy fuel. The worst type of fire season for Southern California is a wet spring, a hot summer, and Santa Ana winds. Such was the case during the fire years of 1967, 1970, and 1980. In 1993, Southern California experienced a wet spring, a dry summer and Santa Ana Winds. Over 250,000 acres were burned during the Santa Ana Wind events.

A. Temperatures:

As an onshore weather pattern is standard through much of the early and mid-fire season, temperatures vary, but as a general rule will follow this daytime pattern: 70 to 80 degrees in the intermediate coastal areas (1-5 miles inland), 80 to 90 degrees in the coastal plains and valley areas, (5-20 miles inland), 80+ in the mountain areas (20-50) miles inland and 100+ degrees in the desert areas (about 50 plus miles inland). Night temperatures depend on the time of the season but generally cool rapidly in the coastal and mountain areas but remain warm in the valley and desert during the summer months.

B. Humidities:

Humidities will range from 20 to 40 percent, depending on the distance from the ocean. In costal and inland areas, humidity recovery is fast and can cause major problems with backfire and burnout operations. Coastal fog will keep morning and mid-afternoon humidities up and temperatures down. Coastal fog usually occurs in May and June. Conditions at higher elevations may be much hotter and drier than in the coastal valleys areas. Coastal fog may require the movement of aircraft from one location on the fire, and from one air base to another.

C. Wind:

Because of the relationship of the desert plateaus and the Pacific Ocean, the normal wind pattern is west or southwest. Winds will vary during daytime from 5-15 MPH. Due to surface heating in the inland valleys and desert, the onshore flow will increase during the afternoon hours. Downslope winds will start at dusk and be in the 5 to 10 MPH range. They normally stop at dawn. This wind cycle is known as a diurnal variation. The downslope winds are strongest at the base of the mountains and river drainages.

D. Special Weather Conditions:

There are special weather conditions which are important to be able to predict and recognize. These conditions are as follows:

1. Santa Ana Conditions.

Santa Ana Wind conditions occur when a high-pressure system develops over the Great Basin area. Air will move from the high-pressure system to the low-pressure system over the Pacific Ocean. All aspects of change are a follows:

a. Wind – The normal pattern of onshore flow reverses dramatically to a high velocity offshore flow. Santa Ana's are a gradient foehn type wind which cause extreme fire conditions. The wind will blow from 30 to 50 MPH, and has been known to gust to 90-100 MPH. During the 182,000 acre Laguna Fire (1970), wind conditions were reported to be 80-90 MPH and the fire spread at an average rate of 6000 acres an hour (between 450 and 500 chains per hour) for 19 hours straight! The winds often blow strongest at night and during the early morning hours. During light Santa Ana's, you may get a light westerly flow in coastal areas. These winds normally last for about three days. The last day of a Santa Ana will change to the regular onshore flow but will return the dry air that was pushed out to sea. This is sometimes called an ebbing Santa Ana. This wind change will cause the fire to change direction and can pose a hazard to fighters. You should closely monitor the predicted wind changes.

b. Temperature – Temperature will gain about five degrees per 1000 foot drop in elevation and will be in the 80's in the mountains and in the 90-100 degrees range in the lower elevations.

c. Humidity – Humidity will drop rapidly with the onset of the Santa Ana. It may decrease to between 5 and 10 percent and has been recorded as low as 1 to 2 percent. Fuel moisture will drop rapidly, especially in the 1 and 10 hour fuels and go down to 2 and 5 percent range.

d. Sundowner Winds – The Sundowner is also a gradient downslope type wind. This special condition takes place in the Ojai and Santa Barbara front country, some 90 miles northwest of Los Angeles. The difference with the Sundowner is the speed in which it develops and diminishes. The areas in which Sundowners occur involve the steep slopes, which rise adjacent to the Pacific Ocean and the desert plateau immediately behind the mountain range. These two vastly different areas in close proximity cause a micro-climate to rapidly develop when there are temperature differences between the desert and the oceanfront. The air in the micro high-pressure flows to the micro low-pressure area of the oceanfront. This air is enhanced by the normal down canyon wind starting around sundown. The air compresses and heats as it flows down the mountain slopes towards the ocean. Sundowners have all of the same characteristics as Santa Anas (temperatures increases, humidity drops, etc.) but these events happen much more rapidly. Due to the rapid onset, Sundowner winds have caused fire deaths such as the Romero Fire in 1971, on the Los Padres National Forest where four fatalities occurred.

XI. NORTHERN CALIFORNIA TOPOGRAPHY

Water, volcanic, and glacial events in the Northern California region have created a great variety of landforms ranging from coastal dunes to rolling hills and steep, highly dissected hillsides.

Elevations range from sea level to over 12,000 feet. Forest zones are coniferous. In this Geographic Area, elements of the eastern forest meld with some of those coastal areas. The area is typified ponderosa pine forest. The areas include the Klamath Mountains, which are characterized by rugged, deep dissected terrain and knife-like ridges. Northern California has high lava plains characterized by young lava flows of moderate relief, interrupted by scattered cinder cones and lava butts. The surface layer of pumice varies from a few inches to 20 feet deep in places, and was deposited by air currents during the last major volcanic eruptions. This is a land where rocks float, wood sinks and soil burns.

XII. CENTRAL CALIFORNIA TOPOGRAPHY

The topography in the Central Sierra ranges from 2000 to 13000 feet elevation. The east side of the range is primary desert; the west side is primary grassy valleys and farmlands.

A. Topographical Features:

The topography consists of steep slopes, valleys, and canyons. In most of the Central Sierras, lakes, streams and ponds are plentiful. The mountain range runs north and south with numerous canyons and valleys facing east and west.

B. Access:

Access consists primarily of some paved roads, logging roads and hiking trails. Major east/west roads are limited in many areas. Helicopter transportation and walking can be primary transportation modes. Fires with limited access present substantial logistical problems.

XIII. SOUTHERN CALIFORNIA TOPOGRAPHY

The topography in Southern California is unique. It consists of coastal and inland valleys, which lead to mountain ranges with elevations from sea level to over 11,000 feet. The change in elevation from the base of the mountain slopes is very rapid; slopes in excess of 40% are common. The rapid change in elevation can result in fuel type changes over a relatively short distance. Most fires occur in the 1,000 to 5,000 foot elevations. East and north of the mountain ranges are primary desert plateaus.

A. Topographical Features:

The topography consists of broken canyons with many steep side drainages. Such topography causes uneven surface heating, radical changes with fuel conditions, opposing wind directions and resulting erratic fire behavior. Other unique feature include:

1. Chimney and chute canyons – Chimneys and chutes are common and vary in depth from a few feet up to 1000 feet. Many firefighters have been killed in or above these topographical features, such as during the **Loop Fire** on the Angeles National Forest in 1966, when 12 firefighters lost their lives.

2. Steep rock areas - Steep rocky areas can make firefighter access difficult and provide additional safety hazards to personnel.

B. Access:

A good road system, major freeways, county roads and forest roads provide rapid access to many areas and also provides natural fuel barriers. Major roads are quite often used as control lines and anchor points. This is why engines are a primary resource.

XIV. NORTHERN CALIFORNIA FIRE BEHAVIOR

Wildfires in mixed conifer fuels burn hot at moderate rates of speed. Drought conditions have been prevalent during the past 11 years in many parts of Northern California. During extended drought conditions accompanied by severe dry thunderstorms, hundreds of fires have been produced, resulting in extremely intense burning periods. In 2000, fires burned from late May through late August throughout Northern California. Convection columns can rise in excess of 35,000 feet and produce long range spotting. Extremely low humidities can result from large-scale subsidence of air from very high levels in the atmosphere. Catastrophic fire seasons (1977, 1987, 1989, 2000) usually begin from the long-term drought conditions.

Critical fire problems are in lodgepole, lodgepole subalpine types where 50% of the lodgepole pine is dead and "jackstrawed". In these stands, tree moss and dead aerial fuels such as small twigs, have the greatest influence on crown fires. Trees located with moss and lichens that extend from the tips of the trees to the ground present the worst conditions and can produce blow-up conditions.

Smoke inversions over large fires needs to be watched carefully. These inversions can persist for days over a large wildfire in this region. Large fires can produce convective lifting and break through an established inversion creating a blow-up condition as new air is introduced to the fire.

XV. CENTRAL CALIFORNIA FIRE BEHAVIOR

Wildfires in mixed conifer fuels burn hot at moderate rates of speed. Average chains per hour range from 10 to 15. This can increase dramatically when spotting begins to occur. A typical wildfire in mixed conifer fuels will burn hot and be influenced by slope during peak burning periods. At night the fire will lay relatively dormant until mid-morning and repeat the pattern. This pattern is often complicated by thick smoke inversions in canyons and draws. During drought conditions, extremely intense burning can occur in mixed conifer fuels. Convection columns can rise in excess of 35,000 feet. After an intense fire run, the convection column will flatten out or break up. When this occurs it can result in numerous spot fires sometimes miles in front of the fire. This will often result in a number of fires, which leaves difficult control and mop-up problems.

Spotting is always a problem in mixed conifer fuels. Currently, as a result of many years of drought, dead fuels are abundant. There are pockets, 30 to 50 acres of standing dead material. Fire, as it spreads into these areas, burns intensely and sends bark platelets high into the convection column. This results in usually violent fire behavior and long distant spotting. Due to heavy duff layers, mop-up will be difficult and require significant time.

Mixed conifer fuels with young reproduction or mixed brush always present a potential for re-burns. A wildfire may burn through the brush or smaller fuels and later run through the overstory. This is always a dangerous possibility for firefighters.

XVI. SOUTHERN CALIFORNIA FIRE BEHAVIOR

Many firefighters have been killed in Southern California. Fires run hot and fast. A typical fire from July through August with a normal onshore flow (10 to 15 MPH wind) will burn 175 to 200 chains per hour with flame heights of 20 to 25 feet on moderate slopes. Spotting can be expected.

In September, October, and November, fires will burn 250 to 275 chains per hour with flame lengths greater than 30 feet. Moderate intermediate and long range spotting is common.

Wildfires in chaparral will slow and rapidly lose intensity as they reach the 5000 foot elevation range. Normally, evenings will cool and fire intensities will subside substantially. Canyon bottom and mid-slope runs still occur, however sustained runs with high intensities is the exception under normal conditions at night.

Unless the area is under extreme drought conditions, fires under normal onshore wind conditions will not continue to run or carry through the mixed conifer stands at higher elevations.

Under Santa Ana conditions, fires will burn with extreme intensity. These winds can occur at anytime of the year, but are most dangerous in the fall when fuel moistures are at their lowest. Rates of spread can exceed 1000 acres per hour and flame lengths of 75 feet or greater are not unusual. Santa Ana conditions cause extreme burning at all hours of the night and day. Long range spotting up to a half mile or greater can occur.

Santa Ana fires are influenced by the wind with virtually no influence from topography. Once the Santa Ana Winds start to subside, there will be various wind changes from opposite directions as the onshore flow tries to overcome the high pressure air movement from the east. Fire behavior during this transition can be confusing and dangerous.

XVII. IMT CONSIDERATIONS

A. Incident Commander:

Incident management teams who are assigned to an incident should be prepared to enter into a unified command mode. There are a number of fire agencies/departments with major wildland responsibilities. There are literally hundreds of other agencies/departments that have limited wildland capability and responsibilities. Some of the primary agencies include:

1. United States Forest Service (USFS)
2. Bureau of Land Management (BLM)
3. Bureau of Indian Affairs (BIA)
4. National Park Services (NPS)

5. United States Fish & Wildlife Service (FWS)

6. Military

7. California Department of Forestry and Fire Protection (CDF)

8. Los Angeles City Fire Department

9. Los Angeles County Fire Department*

10. Ventura County Fire Department*

11. Santa Barbara County Fire Department*

12. Orange County Fire Authority*

13. Kern County Fire Department*

14. Marin County Fire Department*

15. San Bernardino County Fire Department*

16. Local Fire Departments

17. National Guard

* Counties, which contract with CDF for initial/extended attack wildland protection

Type 1 teams taking over a fire in California must be sensitive as to how they will be viewed by other agencies. A team may be working in the "fish bowl" of the fire world. How a team is judged will not only based on how well they manage the incident, but also how they interact with locals. **Be Professional!**

There are three agreements that the IC and team will need to be aware of while managing an incident in California. The first are **Local Agreements**. These are agreements that a local Forest, Park, Reservation or other unit will have with its neighbors or cooperators. These can cover items such as response plans, local interagency incident management teams or any other need. The next agreement is the **Four Party Agreement.** This agreement is between the USFS, BLM, NPS and CDF. The agreement outlines how the agencies will share resources, how items such as billings will be handled and other key elements. The last one is the **Five Party Agreement**. This agreement allows the Federal agencies to use local government resources. The Governors Office of Emergency Services Fire Rescue Branch (OES) acts as the broker for these resources. OES is not a full time agency although they have over 100 engines throughout the state. The engines are staffed and maintained by a local fire department/district. The OES Assistant Chiefs, who are assigned to an incident, are in the role of agency rep, not only for OES but local government fire resources.

* California and Oregon have master co-op agreements with the Forest Service and the Department of the Interior.

Most fires in California will have structures in the fire area. The I/C should determine who the key agencies are to deal with for structure protection issues and responsibilities. Even smaller fires can have great structural losses. Some of the biggest challenges the I/C will have to deal with could be loss of many homes and how the new Federal Fire Policy was put into use.

California has more Congressmen/women than any other state. There are numerous small towns, big cities, and other communities with elected officials and fire departments. It is important for the team to work with these elected officials. It is particularly important to include local fire personnel when planning structure protection. Treating local with respect will be important. The team will be remembered for their courtesy as well as how they managed the incident.

A union representative may be assigned to the incident. This person will work with/represent members of the union if and when issues arise. Each incident will have one or more Human Resource Specialists assigned. They will most often work for the I/C and will be responsible for comprehensive reports on issues that arise. California has a general policy of not closing Bases or Camps. A closure can be implemented with the Agency Administrator. A minimum of 20 trainees will be assigned to every type 1 incident. Staffing the Training Specialist position will be important to manage the paperwork and administrative requirements of this job.

Fires will impact local tourist and vacation income of some of the smaller remote communities. Many of the high use areas are booked months or even years in advance. The industries of the area may suffer. These could be the logging trade, the farting companies, the lake recreational businesses or rental properties. The I/C may have to work with the local office to lessen the impact.

B. Safety Officer:

California has poisonous rattlesnakes, scorpions, ticks, and bees. People who are allergic to insect bites should carry medication for anaphylactic reactions. The Pajahuello tick can cause severe damage to the surface skin and underlying tissues; lyme disease can be a serious long term health hazard. Proper clothing and sleeping arrangements will help prevent bites. Stay away from rodents and rodent burrows, hanta virus is beginning to be serious problem. The Africanized honeybees have moved through Southern California and are heading north. Poison oak can be found in or near shaded areas where fuels are moister throughout the state. Bears are attracted by food; keep fire lines and sleeping areas clean. Giardia Lambia can be found in many streams throughout California, so advise fire personnel to not drink the water.

Heat exhaustion and dehydration can be a major problem for firefighters. Firefighters need to carry, be supplied with and drink lots of water. A rule of thumb would be a minimum of two gallons per operational period.

Firefighters should be encouraged to drink large amounts of fluids during off time as well. It is also important that incident personnel get quality rest and abide by the two-for-one work rest guidelines. This could mean tents with coolers for day sleepers. On the reverse side, fire at higher elevations may get rain from thunderstorms and the personnel will need protection from moisture.

Traffic, both on the ground and in the air can be real safety concerns. There are many well-traveled roads that will provide routes to and from the base to the incident. These routes could include major freeways with lots of traffic, and logging roads with large truck traffic. Air operations can be very complicated. Smog, fog and smoke inversions will often cause poor or limited visibility. There are numerous private, commercial, media and military aircraft in the area, along with some densely populated areas with all of the associated hazards (power lines, antennas, etc.). Temporary flight restrictions will need to be declared over and around the fire area. Because of the numerous low level military training routes it is important to double check with the military to assure they are aware of the restricted air space.

Flashy fuels can react to changes quickly and look innocent, then explode. Fatalities have occurred in light flashy fuels on flat ground as well as steeper terrain. Older stands of brush, where the dead-to-live ratio is great, can be explosive and react like flashy fuels designed arranged to burn.

Snags have caused many injuries and fatalities. Snags are one of the most important fire line safety considerations in mixed conifer fuels. Night operations can cause increased hazards. Due to drought and bug kill conditions, there are numerous acres of dead/dying trees through the region. Fire damage or winds developed by the fire can cause an increase in the snag problem.

Steep terrain can cause a number of safety issues. Difficultly in working up, down, or side hill can lead to falls and the associated injuries. Rolling materials must always be considered in steep terrain.

It is essential to have firelines anchored to a safety zone or to create safety zones as work progresses along the flanks. All fire personnel must abide by the 10 Standard Fire Fighting Orders and the 18 Situations that “Shout Watchout” in accordance of the **30-Mile Abatement Plan**. Determining safety zone dimensions based on percent of slope, height of adjacent timber and adjacent fuel loading is a critical assessment that must be done in a timely manner.

All personnel must have **Red Card Qualifications** check before they are assigned to the incident. All assigned personnel must adhere to the 30-Mile Abatement Plan.

C. Information Officer:

Demands for information are high as information is BIG business. There are numerous network and local television stations and many of them have their own helicopters. The live coverage of breaking stories or stories of interest

will be shown almost all day. There are hundreds of radio stations and newspapers that will also want information. There are many of these news agencies that are Spanish only. The information STAFF (a single IOFR will not be able to handle all of the demands) will need a coordination plan to shepherd the media around. The mobile remote van is the weapon of choice for the live coverage on the ground and there could be 10 or more on the incident in different locations. They like to park in the same locations that Operations likes to stage resources in, and this can cause some issues.

Depending on the agency the team is working for, the Agency Administrator may want control over information. They may want to staff information centers. It is important to find out how they want to handle this. Information personnel should provide information to local communities. The team may be asked to give briefings at local shopping centers, business groups, social groups, the governing bodies and schools. Information centers should be staffed during business hours and in some cases into the evening hours. This is a great opportunity to educate the public.

There is a great chance that there will be a number of cooperating agencies working the incident. The team may be working under a unified command. If this is the case, the Information Officer should think about a unified staff. That local agency will have contacts in the community and the media. It is very important that credit is given to all the major players on the incident. This will also include the non-fire organizations.

D. Plans:

Rapidly changing conditions combined with media feed updates will require the Situation Unit staff to work very hard to keep their information current. In some cases, intelligence may be difficult to obtain. Some inversions of fog may make fire perimeter locations difficult. Infrared or other aerial heat detection mapping system may be critical.

The tracking of resources may be an issue early on in an incident. With a number of different fire agencies responding, it will be critical to get an accurate tracking of all resources. Some of the local fire departments will change people on an engine and leave the same engine on the fire for all the operational periods. The information needs to get to other team members so they can plan accordingly.

Long range Planning will be the key to success on many incidents. Intelligence gathering and contingency planning up to 72 hours in advance will be needed if something goes wrong. The Fire Behavior Analyst will be the key to much of this planning. In many areas where structures are involved or will be involved, structure protection plans will need to be written. Evacuation plans may be needed also.

There will be a number of environmental considerations that may require specialists. There are many archeological sites, sensitive habitats, wilderness areas and T & E (Threaten & Endangered), both plant and animal, that will need special consideration. Other special considerations will include air and water quality concerns. Rehab will need special consideration in

many areas. There are a number of BAER (Burn Area Emergency Rehabilitation) teams available in the state.

E. Logistics:

Base locations are not a usually a problem to locate in the Southern and Central areas of California but can be on large fires in Northern California. The issue may arise when a base is located close to towns/cities or commercial facilities. Security is important to safeguard equipment and keeping those who don't belong out of the base. Except that in more urban areas, people and cooperators will want to donate a whole variety of materials, products, services, and food. Close coordination and constant vigilance will be required to handle the situation and its potential ramifications. Some fires will be in remote areas where supplying a base can cause some challenges. Buying units should not have any problems supplying items that are not in the caches. Recycle facilities should be set up and many organizations will take the items. Hospitals and burn centers are usually close by. Many have heliports, so air transport is not a problem.

Contract equipment such a dozers and water tenders are in good supply depending on the number of incidents in the state. Many of these types of resources are already signed up on contracts prior to fire season. Moving large dozers on weekends will cause problems for timing their release. They cannot transport from Friday night until Monday morning without a special permit, which may take a few days to process. Ground Support should get accurate counts on water tenders, dozers and other contract equipment as soon as possible. The tracking has become more difficult as some of these resources are called or dispatched on initial attack. Demob inspections will need to be well planned due to the amount of rolling stock. In an incident where there is a large structure threat, Logistics could inspect 30 or more strike teams of engines, all wanting to leave at the same time.

Communications can be a challenge in some areas in Southern California. Bleed over from Mexico or other illegal radio transmissions can interfere with radio traffic. If there are a number of incidents going on in an area, close coordination will be needed between incidents.

Spike Camps and/or Coyote Tactics are sometimes necessary because of logistics. If these tactics are established, they are often supplied by helicopter long lines. Timing of loads, adequate water and food are critical. Good communications between the Operations Section group and Logistics is essential.

E. Finance:

Coast share agreements will be a big concern when dealing with multi jurisdictional incident. These agreements can be very simple to complex. The main point is to have all the agencies sign the agreement that have responsibility for the other lands involved. Most cost share agreements will be with CDF. Cost apportionment then becomes an important task for the incident. There are many ways to do the apportionment; "you order you pay", burned areas or acres, and resource assignments are some methods. There

is a cost apportionment technical specialist available to do the day-to-day work on the apportionment. They can be ordered through the system. There may be local fire departments that know little or nothing about cost apportionment that will have to be educated. Cost information may be hard to gather from some local agencies. They may not have developed daily cost for equipment or personnel. OES has some basic cost rates for reimbursement that can be used until more specifics can be obtained.

If the incident has, or is going to involve structures, the claims people assigned to the incident are going to be busy. There may be city or county departments, which will need to interface with the claims shop for information regarding damaged or lost structures. Land use agreements and a lot of people wanting to be hired by the incident may present some issues. Local fire agencies should bring their own worker's compensation forms to the incident to cover their personnel. This may not always be the case. The Comp Unit may have to walk them through the process or make contact with the headquarters to get the proper paperwork. It will not be uncommon to get a strike team of engines made up of one engine from five different fire departments.

Time keeping on a multi-agency incident can present some different challenges. CDF will bring their own timekeepers and the OES assistant chief assigned to the incident can help with the local government resources assigned. Most all of the fully paid departments, which respond to the incident, will be on "portal-to-portal" pay status. The time unit will not need to track the individual times for the personnel. Some of the local departments will trade personnel on the resources on a daily basis and keep the time at their home office. OES has a form, FC 42 that is used to track the overall time of local government resources assigned. They will need the Finance Section Chief to co-sign with the OES representative on the form at demob. The Finance section will need to gear up and be prepared for demob if a large number of engines or crews will be released at one time. How long will it take to process 100 plus FC 42's?

F. Operations:

Coordination with multiple agencies will be the key to success in many incidents. Resources will, in most cases, be abundant. The challenge will be the communications and coordination to meet the objectives. Fires move fast and constantly threaten improvements on multiple jurisdictions. It is important to have a person with local fire experience for input into the planning process. Fire history maps are available in most areas. Many fire tend to repeat themselves and much can be gained from studying the historical data.

The tactical resources and some strategy and tactics have been broken down in the Northern California, Central California, and Southern California.

XVIII. NORTHERN CALIFORNIA STRATEGY AND TACTICS

A. Strategy:

One foot in the black is the preferred strategy in all fuel types. Sometimes it is necessary to construct a fireline downhill. This is a hazardous practice when done in fast-burning fuels and steep topography, because of the danger that the fire may cross the slope below the crew and sweep uphill to trap them. A fireline should not built downhill in steep terrain and fast-burning fuels, unless Lookouts, Communications, Escape Routes, and Safety Zones have been established. The 30-Mile abatement plan must adhere to.

B. Tactics:

Tactics are those specific actions taken to accomplish the over-all strategy.

1. Direct Attack.

Direct attack with one foot in the black is the preferred. Cold trail when possible to avoid reburns escaping. Direct attack reinforced by a hoselay with laterals every 200 feet is very effective in most fuel types. Night operations are very effective once hazardous snags have been mitigated. Direct attack, aggressively pursued, will be favored with indirect and backfiring used after all other strategies have been subjected to a Wildland Fire Situation Analysis (WFSA).

2. Indirect Attack.

Indirect attack is used when erratic, severe or extreme fire behavior usually has one or more of the following present:

- Presence of Firewhirls.
- Prolific Crowning and/or Spotting.
- Very High to Extreme Rates of Spread.
- A Tall, Well-Developed Convection Column.

Conducting backfiring operations requires great care in timing. All the conditions must be right and all safety precautions must be in place.

3. Wilderness Fires:

Suppression actions and techniques must be selected and implemented to result in the least impact on the Wilderness resource and the least possible long-term evidence of human activity.

It is appropriate to accept moderate risk associated with the use of confinement/containment strategies. The effects of the fire are most often more acceptable than the adverse effects, on the Wilderness resources of

a control strategy or direct attack. The key is to balance suppression impacts with risk, which may vary in each fire situation.

The Wilderness Act defines Wilderness as an area "to be affected primarily by the forces of nature with man's work substantially unnoticeable".

Fire suppression actions in Wilderness shall be those, which achieve the Wilderness protection objectives, with minimum adverse impacts on the Wilderness resource.

4. Minimum Impact Suppression Tactics (MIST).

MIST guidelines are used extensively, within this are for both wilderness and non-wilderness fires. Actual guidelines are agency specific and should be provided during initial briefings to incident management teams.

XIX. CENTRAL CALIFORNIA STARTEGY AND TACTICS

A. Strategy:

Strategy is the over-all plan for an incident. Strategies in mixed conifer may be somewhat different than that of chaparral. Fires in mixed conifer fuels usually require thinking bigger and looking for opportunities well out in front of the fire.

B. Tactics:

Tactics are those specific actions taken to accomplish the over-all strategy.

1. Direct Attack.

The best method for attacking fires in mixed conifer fuels is direct attack. This method may not always be possible. If the fire demonstrates any of the characteristics listed below, direct attack may not be possible.

a. Running in the crown.

b. Long distant spotting.

c. Substantial convection column.

d. Influenced by mono and east winds.

e. Burning in heavy logging slash or windfall.

2. Indirect Attack.

If direct attack is not possible, a combination of parallel attack on the flanks and indirect on the head may be necessary. It is critically important to build long-range contingencies. Look for topographic opportunities in

front of the fire, which allows sufficient time to execute. Backfiring operations must be well-planned and carried out only under ideal weather and burning conditions. If the fire is running and spotting, backfiring operations may make the situation worse. Considerations should be given to burning at night, if practical. In many cases, it will require a change in the weather conditions, which are causing extreme burning conditions before you will be successful in halting the spread of the fire. It maybe important to think in terms of 72 hour planning rather than 12 to 24.

Mop-up will be a difficult job. All fireline should be black and mopped up entirely 100 feet inside. If foam can be used, it will make the job easier (Mop-up in these fuels is very difficult).

XX. SOUTHERN CALIFORNIA STRATEGY AND TACTICS

Strategy, as previously stated is the over-all plan. In Southern California, Type 1 teams will most always inherit a fire from an existing Type 2 team. There will normally already be a wildfire situation analysis. Work with the Agency Administrator if changes are required.

A. Strategy.

Initial attack strategies in Southern California include fast, aggressive initial attack. Due to land ownership patterns and rapid rates of spread, fires usually involve several jurisdictions and threaten structures and other improvements.

B. Tactics.

Tactics are those specific actions taken to accomplish the over-all goal (strategy). Your tactics will be based upon the right equipment (both in quantity and type) to suppress the fire safely, and meet all of the incident objectives. Your tactics will be developed based on current and expected fire behavior.

1. Direct Attack.

In Southern California it is always safest to employ direct attack. Because of the steep terrain, it is not always possible to see the entire fire. Because of numerous canyons and broken topography, the wind can be erratic. Add to these factors the flashy fast burning fuels, direct attack is obviously the safest tactic. In chaparral fuels, it is always best to have “1 foot in the black” whenever possible. During Santa Ana Winds, it is best to flank the fire, as it is virtually impossible to stop the head of the fire during these conditions.

If the fire is too intense for direct attack, parallel tactics can be used. Parallel tactics involves getting far enough away from the fire to avoid the heat and still see it. Line is fired out as it is constructed.

2. Indirect Attack.

   Indirect attack is usually employed when the fire is already large and other tactics are not safe or appropriate. It is risky and must be well planned with all of the necessary safety precautions including lookouts. Communications, Escape Routes, and Safety Zones (LCES) strictly adhered to. Burnout or backfire will normally be used in conjunction with indirect tactics. Burning must be well planned and executed. Burning must always be accomplished with favorable wind conditions, with adequate resources and when the exposure of the fuels is appropriate. Southern California fuels will often be difficult to ignite if they are shaded (cold) and will suddenly take off with greater intensity than anticipated once exposed to the sun (hot). Most of the firefighters killed in Southern California have died during indirect attack operations.

   When fire intensity is extreme, such as in Santa Ana conditions, the tactical posture may be primary defensive rather than offensive, since the conditions make offensive tactics futile and dangerous. Protection of structures, critical watersheds, or other values may be the only tactic that is attainable. As offensive opportunities present themselves, it will be important to be prepared with resources to take advantage of them. This posture may continue until the conditions change and the fire's intensity reduces.

3. Structure Protection.

   Structure protection will quite often take away many of your wildland firefighting resources. You will have to make tough judgments on resource allocations. When possible, allocate structural protection to the local structural protection agency and when applicable involve them in a unified command structure. One of the biggest challenges an Incident Commander will encounter is attaining perimeter control when structures are involved. The best over-all structure protection strategy is to control the wildfire.

   Type 1 and Type 2 engine strike teams are often ordered for structural protection assignments. However there may be times a mixture of Type 2 and Type 3 engines may be more appropriate. When making tactical decisions consider:

   - Firefighter Safety. **(ALWAYS OUR FIRST PRIORITY)**
   - Rescue-evacuation.
   - Available Engines.
   - Location of Homes.
   - Roof Coverings.
   - Rate of Spread.

- Direction of Spread.
- Engine Access.
- Water Supplies.
- Defensible Space.

XXI. NORTHERN CALIFORNIA TACTICAL RESOURCES

A. Hand Crews: In large fire conditions, hand crews will be one of the primary resources. Crews are available throughout California. Type 1 Hotshot crews are positioned throughout the State, but might not be available depending on fire activity throughout the United States. Additional Type 1 Crews from CDF are positioned throughout California also along with several Type 2 crews. Contract crews from Oregon and Washington are use in Northern California on a regular basis.

B. Smokejumpers: Smokejumpers are available from Redding and several western states. They may be helpful in jumping or repelling into isolated spot fires or multi-lightning fires if this can be accomplished safely. They can also provide Paracargo operations for remote fires.

C. Dozers: Dozers are in constant use for fire suppression in Northern California area because of heavy fuels complexity. Dozers are extensively used on large fires as the main line building method. They are more likely to be used where fires have escaped initial attack, rather than during initial attack. Dozers are often used to reopen logging roads ahead of engines.

D. Engines: Fire engines will be useful if the fire is accessible or is structures are threatened. Type 3, 4, and 6's are preferred due to forest and old logging road accessibility. Engines provide support for mop-up operations and hoselay support. Engines are readily available throughout California with additional contract engines available from Oregon and Washington.

E. Air Operations: Air Tankers drops are valuable in slash models, young plantations and for protecting high resource values such as cable logging sites. Old-growth canopies break up the drop patterns usually making then ineffective. The Northern California area has a fleet of mostly Type 1 air tankers under contract yearly.

Light helicopters are useful for scouting, air tactical safety, lookouts, and logistical support. Because of the density altitude, and heavy fuels, the water bucket loads on light helicopters are not effective.

Type 1 and 2 helicopters with water buckets or fixed tanks with foam, are effective in the various fuel types provided there is less than 5 minute turn around time from a water source. Water bucket operations can be supported with a fold-a-tank for shorter turnaround times. The type 2 helicopters can also be used for crew movement and logistical. Consider spike camps rather than daily movement of large number of crews via helicopters. Aerial ignition,

commonly used in prescribed burning has gained wide acceptance in wildland fire suppression. California has several Helitorch modules consisting of qualified personnel to provide this tool if needed.

E. Water: It is plentiful and is commonly used. Engines, water tenders, hose lays with accessories are plentiful throughout the area. All agencies have water-handling specialist that can assist an incident management team in the installation of progressive hose lays in the most adverse terrain. Utilize opportunities for gravity water system

XXII. CENTRAL CALIFORNIA TACTICAL RESOURCES

A. Hand Crews: In large fire conditions, hand crews will be one of the primary resources. It is not uncommon for fires to be in remote areas with limited road or heavy equipment access. There are numerous crews available in California.

B. Dozers: If the topography permits, dozers will be invaluable. They will particularly important in implementing contingency plans where firing from a wide fire break required.

C. Aircraft: Aircraft will be vital, both fixed wing and rotor wing. Air Tankers will assist not only supporting crews, but also in knocking down spots. Rotor wing will be necessary for tactical operations as well as logistical support operations. Crew transportation will most likely be accomplished with helicopters. Remote camps and coyote tactics may be necessary. Helicopters will be key to the success of these operations. Aerial ignition for firing operations may also be required. Heavy lift or Type 1 helicopters are very effective for water and retardant dropping in mixed conifer.

D. Engines: fire engines will be useful if the fire is accessible or if structures threaten. Smokejumpers may be helpful or repelling into isolated spot fires if this can be accomplished safely.

XXIII. SOUTHERN CALIFORNIA TACTICAL RESOURCES

A. Engines: The primary attack tool in Southern California is the engine. There are literally hundreds available with quick attack times due to a good urban and rural highway system.

Wildland engines normally carry 500 to 1000 gallons of water, a 250 to 500 GPM pump, and about 2000 feet of hose plus hand tools. Hose lays and mobile pumping is done on most fires. A number of wildland engines in Southern California are equipped with Class A foam, which proved to be invaluable during the 1993 Santa Ana fires. Many fire departments are currently equipping many of their engines with this capability.

B. Hand Crews:

- Abundant in Southern California.

- All are fully trained and equipped. They have radios and are mobile.

- All have qualified fire line supervision

C. Dozers: Plentiful, several available from fire agencies for initial attack. Many rentals available; however training may be limited. Size D-6 to D-7 is best for the fuel and terrain. Federal agencies have land management limitations on the use of dozers in almost all areas of Southern California.

D. Aircraft: Five air attack bases serve the area within 15 minutes attack times. Terrain favors coordinated attack with aircraft and helitack crews. Approximately 15 initial attack helitack crews are available with both medium and light helicopters. Southern California also has five Type I helicopters (four of them helitankers) capable of dropping 2000 gallons of water and foam. Southern California has several trained helicopter rappel crews that can be used in inaccessible areas.

   Normally, tactics will use a combination of all these resources; engines, dozers, aircraft, and hand crews. At higher remote elevations, operations are usually limited to hand crews and aircraft.