

OREGON STATE COLLEGE

School of Forestry

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RADIO IN FIRE CONTROL

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## RADIO IN FIRE CONTROL

I have worked for the Oregon State Board of Forestry for three fire seasons, (one season as dispatcher), and for the <sup>U.S.</sup> Forest Service for one season. The most striking difference between the two agencies that I noticed was their radio systems. Much has been written on the merits of different types of radios and on the benefits of using radios in fire control, but I have never seen a complete plan for overall fire control radio systems. This report will set forth such a plan as it should apply to the Pacific Northwest fire control agencies.

### THE NEEDS OF COMMUNICATION

A fire protection agency works much the same way as the Army in many respects, and as in the Army, their protection is no better than their communication. Actually the communication system of a fire protection organization is much more valuable than that of an Army. This is because men and means of communication are widely scattered over a forest, and the failure of one of them may mean the difference between one blackened tree or 1,000 acres or more of burn.

### DETECTION

The first step of any fire control is detection, and to accomplish this there must be a means of communication so that help may be called. The major part of the detection

is accomplished by forest lookouts which are located many miles, often by trail, from the closest alternative means of communication. You can imagine the frustration a lookout would suffer if he was left to watch fires burn with no communication. Therefore, our communication system must not only exist, but it must be extremely reliable and not subject to frequent breakdowns.

#### SUPPRESSION

The communication needs for suppression are slightly different than those for detection. Since the location of fires cannot be predicted, permanent installations cannot be used all of the time and mobility or portability must be depended upon. This is the greatest problem of any fire protection organization because in general, reliability must be sacrificed for portability. Besides its portable communication, a suppression organization needs permanent installations at such places as guard stations, on patrolmen's trucks, and at headquarters. Of course, both detection and suppression organizations need to be connected to each other. Together they form the fire control communication net and should never be separate.

#### TELEPHONE COMMUNICATION

The telephone was in use long before the <sup>U.S.</sup> Forest Service was organized, and since the Forest Service was the first protection organization, telephone was the first



means of communication. Basically, they used two different methods of phone service; one for communication between headquarters, and one for short distance, district use.

#### LONG DISTANCE PHONES

The telephones used for headquarters communication were of the same type as we commonly use today and were effective for long distances. These phones had two wires for each set, <sup>providing a complete circuit.</sup> ~~One for the actual transmission, and one for a ground.~~ Generally established commercial lines could be used, but in some remote areas the line had to be built from scratch at considerable expense. Because this type of phone system was so dependable and permitted "talking things out", it is still in use today by all protection organizations for between headquarters communication.

#### SHORT DISTANCE PHONES

The type of phone that has always been used for short distances in protection districts used only one wire for each set. This wire ~~carried~~ the actual transmission, while the earth itself served as the ground. This type of phone system is very crude, but at the time was practical because most of the stations were occupied only in the summer months. Many miles of wire had to be strung for each phone, and was in constant danger of damage because of snow, falling trees, and windstorms. While it was a very good means of communication when it was working, it required a good

deal of maintenance every spring and a lot of hiking during other outages. At the present time the State organization and private organizations use this system of communication very little for fire control, but depend almost exclusively on radios. The <sup>U.S.</sup> Forest Service, because of a lack of trust and funds, still leans heavily on the system. On some stations they have even located both a phone and a radio.

#### PORTABLES

The biggest drawback of the two phone systems just covered is that they have no portability at all. The Forest Service alleviated this situation early in their history by designing a pack phone set that could be hooked into either type of phone system anywhere along a line. Many other sets have been designed since, but they are all heavy for their size because of the heavy, iron magnet required for ringing. These sets were not too successful because they had to be located on an existing phone line, and fires were generally not very close to one. At any rate they were better than nothing and served all the protection agencies until radio was adequately developed. The pack sets are still used for semi-permanent installations by the Forest Service.

#### DEVELOPMENT OF TWO-WAY RADIO

Of course when radio was first developed we had a two-way radio, since by putting the first transmitter and the first receiver together made it two-way. But



we aren't concerned with that here. We will deal with the development of the modern radio which <sup>is</sup> ~~was~~ practical for fire protection work.

### FREQUENCIES

Radio waves travel the same way as sound waves and light waves. Different radio waves travel at different speeds, because the height and length of the waves are different, (see figure I). In the early days of two-way

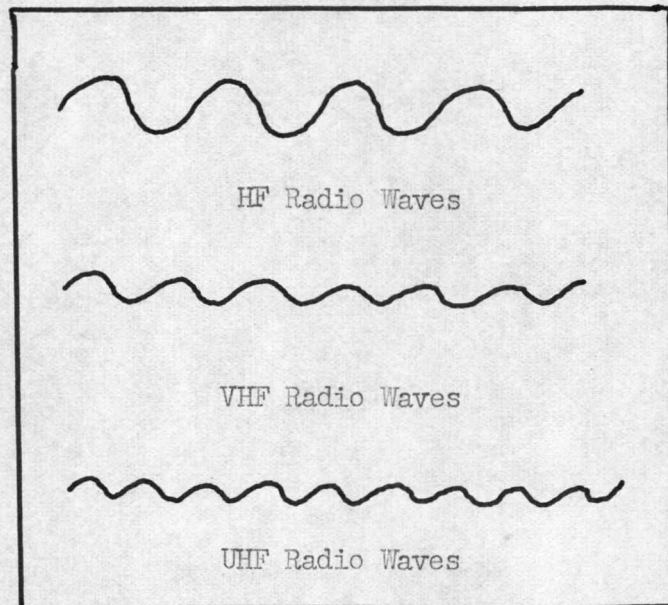


FIGURE I -- Diagrams of Radio Waves

radio, the lower frequencies just above the commercial broadcasting range were used because the waves would carry farther than those of the higher frequencies. This is because the slower moving waves will bend over obstacles while the higher and faster waves would merely bounce off. Radar is an example of a higher frequency radio wave that won't even go through a thick cloud. As the earlier fre-

quencies began to fill up, the higher frequencies had to be brought into use. This report will refer from time to time to three frequencies; high frequency, (HF or AM); very high frequency, (VHF or AM); and ultra high frequency, (UHF or FM). The HF band is located just above the commercial radio band and is followed by the VHF and UHF bands. The HF and VHF bands are both called AM bands by commercial companies, and the UHF band is called FM. These names were given to the bands because of the difference in noise or static between the two. Both the HF and VHF waves travel slow enough to pick up static while the faster traveling UHF waves hardly pick up any noise at all. It wasn't until the lower frequencies were in use for some time <sup>that</sup> ~~before~~ the FM band was used, and then it was greatly advertised by the commercial radio companies.

#### RADIOS

The first radios used in fire control were used only in year-round permanent installations. These radios used the HF band and were capable of reaching long distances. The State used these radios to a great extent while the Forest Service used them experimentally. These radios were not suitable for lookouts, guard stations, or fires because of four reasons; they were extremely large and heavy, they required a lot of power to operate them, they required a wire antenna of over 100 feet, and they needed an experienced and licensed operator. As the higher fre-



quency radios came into use, they found that although they were of shorter range, they were more suitable for fire control work. For instance, the VHF radio was much more compact and lighter than the HF sets, it required a wire antenna of only 10 to 20 feet, it required less power, and the operator neither had to have experience or a license. The State made quick use of this by putting radios on look-outs, guard stations, in trucks, and on fires. The <sup>U.S.</sup> Forest Service continued to experiment with them but on a larger scale, and a few of the larger private companies bought some sets for both fire control and logging business.

HP With the advent of UHF radio during and after World War II, commercial companies started advertising their radios for use in all the industries where instant communication was desirable. These radios are not much smaller than the VHF sets, but require an antenna length of only three to four feet. The Forest Service then started buying these radios in quantity but still proceeded cautiously as far as complete dependency on radio goes. The State at this time had a good and complete system of communication using the HF and VHF equipment and did not make a change to the

HP UHF. Private companies had their attention called to radio by the advertisements and established networks of their own using the commercially built UHF equipment. These radios had a dual purpose however, and in most cases the primary reason for the network was to get logs out of the woods faster and more efficiently.

THE FEDERAL COMMUNICATIONS COMMISSION

The Federal Communications Commission, (or FCC), is the radio regulation agency in the United States. They have control over all radio transmitters and frequencies. In order for an agency to operate a radio network or station, they must first file an application with the FCC stating the type and power of the proposed radio equipment and the usual other things. If the FCC thinks the agency is deserving of a radio frequency in the band desired, it will grant it or suggest a different band. This is the biggest hurdle in trying to establish a radio network. The license requirements vary with individual radio bands. HF and VHF radio sets must be individually licensed while one license will cover an entire UHF network. Also the operator of ~~an~~ HF station must carry an operators' license while none is required for the VHF and UHF operators. In general, other regulations are more strict for the HF band than for the VHF or UHF bands. The regulations are not too limiting on UHF sets since they do not carry far and therefore do not have much of a chance to interfere with other stations. Perhaps the most disagreeable regulation is the one that states that a detailed log must be kept at each permanent station. This regulation applies only to the HF and VHF bands.



### PRESENT RADIO SYSTEMS

The State radio system is now very well stabilized and not subject to change. The <sup>U.S.</sup> Forest Service will more than likely enact some major changes soon because of big differences between districts, forests, and regions. Private companies of course have individual ideas and are hard to predict.

### FOREST SERVICE

Because of the decentralized structure of the <sup>U.S.</sup> Forest Service organization there is much diversity between radio networks in different districts. Without exception they all use commercially built UHF equipment, but the degree and plan of use varies considerably. The radios are very expensive, costing from \$200 to \$2000 for each permanent set. Portable sets are cheaper, notably the walkie-talkie and the handie-talkie. These radios incorporate all of the latest electronic <sup>i</sup>nventions, but they carry embellishments that are not necessary for fire control work. One of these is the telephone-type receiver with a mouthpiece at one end and a receiver at the other. The sets also contain a loudspeaker. A microphone, which takes up 1/3 the room of the phone receiver, and a loudspeaker combination would be better for fire control work. The degree and plan of use of radio varies from intensive use on some districts to only experimental use on others. Since the UHF sets may be used in almost any manner that is desired, radio discipline varies from strict to the point where they

are treated like telephones. Standardization is the biggest need of the <sup>U.S.</sup> Forest Service radio network<sup>s</sup> followed by more specifically designed sets.

#### STATE

The State fire organization is centralized a great deal more than the Forest Service, and therefore needs better long-range communication. The State has frequencies on both the HF and VHF bands. In general, the HF band is used for State-wide communication between headquarters, and between headquarters and project fires, and the VHF bands are used for district communication between lookouts, guard stations, and small fires. The State designs all of their radios and contracts the construction of them to small electronic specialty companies. They maintain a five-man radio shop in Salem which does all the designing and maintenance for all the State's fire control radios. The radios vary in price <sup>to</sup> ~~from~~ \$80 to \$500 for permanent stations, with the portable sets being much lower in price. The radios in general are much smaller and lighter than commercial UHF radios. One factor that contributes to this difference is the fact that the VHF band sets carry the same distance at a lower power than the UHF sets do at a higher power. The degree and plan of use the State has on its radios is very good and is standardized. Radios are used exclusively within districts for communication, and radio is used better than half of the time for communication between headquarters. The procedure for using radios



is very well disciplined because both the HF and VHF bands have strict regulations on them concerning this by the FCC. The FCC is also constantly monitoring these bands. The State actually has no major problem in its network that hasn't already been taken care of.

#### PRIVATE

Private companies all use commercially built UHF equipment. This is natural and right because a private company is not big enough to try and design its own radios. Their networks are all generally basic<sup>al</sup>ly the same. ~~Each~~ usually consists of a large headquarters set, and mobile units mounted in various trucks and pickups. The radio procedure they use is not as important as with a government agency since they don't have many radios, and air time is not at a premium. As a general rule they use their radios like telephones. This is necessary since the radios are used most of the time on logging business which would require long explanations and descriptions. Perhaps the biggest fault of private company radio is that not enough companies use it. All companies that are big enough to be a permanent organization would probably find radio worthwhile providing the FCC would al<sup>l</sup>ot them a frequency.

#### PROPOSED RADIO CHANGES

This section of the report will concern only the U.S. Forest Service and private companies since the State already possesses a good radio system, (although it is not

without fault), and is not likely to change. One improvement that would benefit all three agencies is that of a common frequency. This does not mean that all business would be on one frequency, but that they could take a HF frequency and each have a radio of that frequency in all of the headquarters. This would stimulate co-operation between them; particularly between government and private agencies where it is needed most.

#### U.S. FOREST SERVICE CHANGES

Even though the UHF radios are not strictly controlled for procedure, it would benefit the Forest Service to adopt a well disciplined procedure for the use of their radios. They own and operate a good many sets, and air time is valuable. Wasteful talk and uncertainty on a radio can tie up the frequency for quite some time while other business is waiting.

Radio sets should be installed on all fire control stations as soon as possible. With only part of the stations equipped with radios a big benefit is lost. That is the advantage that all of you<sup>P</sup> people know what is going on at all times and are able to give immediate help or advice without being specifically asked.

The Forest Service should look into the matter of obtaining a HF frequency for region-wide communication between districts. The reason for this goes far deeper than just fire control. The Forest Service is now extremely decentralized into districts, and experience has proven



that in these modern times much more effective work can be done within a centralized <sup>emergency</sup> organization. Immediate and frequent contact between district, forest, and regional headquarters would do much to centralize all types of Forest Service business.

The Forest Service should also try to influence commercial radio manufacturers about their specific needs or set up a radio shop and design their own UHF equipment. The equipment presently manufactured is first-rate, but mobile and pack equipment is much too heavy and <sup>more</sup> bulky than it should be. If a radio shop was set up the initial cost of the equipment could probably be brought down considerably. Maintenance to <sup>it</sup> should be cheaper because of better familiarity with the equipment and sturdier equipment.

#### PRIVATE CHANGES

Naturally private companies are more concerned with getting logs out of the woods than they are about fire protection, and their radio systems are designed around this thought. Most of the sets are located in log trucks, crumbies, and officials' pickups and cars; but most companies also have fire wardens and locate radios in their pickups and tankers. As fire protection becomes more important to the companies, the more radios they will use for protection. Some companies with valuable timber on the coast maintain several wardens, many tankers, and one or two lookouts,

all equipped with radio. It would be impossible for a private logging company to get a HF frequency, but they could put pressure on the government agencies, particularly the State at the present time, to locate a HF set at their headquarters. It would benefit the companies in that they could keep track of weather, closures, timber sales, and harvesting permits very easily. The government agencies would have a valuable way to obtain heavy machinery, power saws, and men for fires that tax their capabilities.

#### CONCLUSION

If all the suggestions in this report were carried out, a logging superintendent in southern Oregon with a pickup in the woods could immediately, (though indirectly), contact a remote <sup>U.S.</sup> Forest Service lookout in northern Washington. This is an extreme example, but it illustrates the point that all fire protection organizations in the Northwest could be drawn together. The Forest Service could be centralized for all business, and they could greatly increase their communications efficiency by standardization of radios and radio procedure.

The most valuable thing accomplished would be the harmonizing of Federal, State, and private agencies. At the present time there is much misunderstanding between the three agencies. Much could be learned by all three agencies by merely listening to routine business over a common headquarters frequency for a few days; and much



more by doing business with each other day after day.

By consolidating in this simple maner everyone would benefit tremendously.

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