

## **Mobile Command Post: Design Issues-Part 1**

By Tony Whobrey, KC4JTV

When designing a mobile command post (CP), there are many issues to consider. This article will cover some of the more important considerations

The obvious first step is choosing a platform; a typical choice is between a trailer and a self-propelled vehicle, such as a van or bus. Former school buses are often suggested as command post platforms, and are often readily available. The drawback is high maintenance costs, which are usually the reason that such vehicles were removed from route service. For many, a trailer-based unit is the best option, since it can be readily moved behind any suitable vehicle. In contrast, if the bus or van-type vehicle doesn't start, repairs could take some time. Self-propelled CP vehicles are probably best left to large organizations with in house maintenance staff and facilities.

The restroom and kitchen amenities that are often found in more elaborate CPs offer obvious advantages. However the frequently overlooked disadvantage is that such facilities too often serve as a beacon to invite others to loiter around your vehicle, causing your operation to eventually resemble a break room or lounge. Excessive foot traffic in and out of the CP is detrimental to smooth operation. If you choose to include such facilities, it may be necessary to formulate a diplomatic way to limit its use to that of your own personnel.

When planning operating position(s), be sure to allow plenty of space. Two positions with adequate room are far superior to three cramped positions. The operator's desk will rapidly fill with logs, notes, pens, and the ever-present coffee cup. If more than one operating position is planned, headphone jacks will be needed at each position. It is nearly impossible for two radios to be employed simultaneously by separate operators in close proximity without the use of headphones. A telephone will also be needed at each operating position, unless your CP is very small. Try to plan placement of positions in order to limit foot traffic, as it should not be necessary to go thru the op position, unless it is to access an adjacent op position.

Once you have decided on placement of the equipment, the next issue is power for its operation. Current commercially produced CP facilities usually power all of the communications equipment from a common 12-volt source, since most modern radio gear requires this voltage anyway. Several vendors have 12-volt fluorescent lighting available, or for those on a tight budget, auto type dome lights could be used. Automotive "back up" or industrial-type floodlights commonly used on construction equipment can light the immediate area outside the command post.

A 12-volt bus can be used, fed by a battery bank with a suitable charging system. Assuming 12-volt batteries in parallel, a means should be provided to permit the removal of a failed battery, while the remaining units continue to provide power. For this reason a minimum of two batteries should be employed. Redundant battery chargers are worth considering if your equipment will require substantial current. Be sure to install a voltmeter, so that the charging system can be monitored. In the case of a trailer-based unit, the tow vehicle might initially be used to provide power, in order for operations to begin almost immediately.

Self-propelled units will typically use the vehicles own engine driven alternator, until AC power can be provided. Commercial power or a portable generator can be used to power battery charging equipment as the operation progresses, as well as to provide power for heating or air conditioning systems. If the generator has to be stopped for fueling or repair, most of the operation can continue without hindrance, using the continuously available battery power during

the interruption. For all but the largest self propelled CPs, permanently mounted AC generators should be avoided because of their seemingly large maintenance requirements.

Provide at least one permanently mounted antenna for each frequency range you plan to use. The better quality antennas sold for mobile use are generally fine for this application. At least some of your radio equipment can be placed into immediate operation with these antennas, and they are usually adequate for short to medium range use. If the command post can be set up on high ground, or operations are in an area where most communications use repeater-based systems, there may be no need to erect a larger antenna array.

When specifying radio equipment for your CP, consider the purchase of a few FRS or similar license free radios. They can be employed for short-range inter-agency communications, as everyone's radios may not be capable of operation on a common frequency. In the initial set-up of your command post, these units will be used while orienting antennas, vehicles and the like. These small radios are best used as a sort of "wireless intercom", they are OK for distances up to several thousand yards, and can be operated by anyone, regardless of his or her level of technical expertise.

Now that all the elements are in place for operation, one more step can be taken to insure ease of operation. The unit should be properly supported to prevent its shaking about during use. The tires and suspension on even a large vehicle will give somewhat when a person enters or exits; this continual movement can be irritating to those who must remain inside over long periods of time. Blocks, jack stands, or wooden cribbing should be provided to support your unit and eliminate most of this unneeded movement. A small floor jack will make this job less taxing, as it provides a substantial mechanical advantage over other types and can be operated while standing.

The eventual layout of your command post will evolve with its use; this should be expected and planned for. Don't be discouraged if a design that sounds and looks good on paper fails in actual use, as it is nearly impossible to forecast the demands that actual deployment will place on your equipment. After the initial use of your command post, preferably in a non-emergency situation, critique its performance. Don't be afraid to modify it to suit the needs of your own group, after all it is your home away from home.

## Mobile Command Post: Design Issues-Part 2

By David Glass, WA4QAL

Regarding choice of platform - trailer vs self propelled...

There are few things more embarrassing than going to get a self propelled command post (CP), and finding that it won't start. Typically, these vehicles are left sitting for considerable amounts of time, and batteries have a tendency to go flat, fuel tends to jell, tires tend to go flat, and various other problems occur. While some of these things can also happen to trailer based units, they're usually a lot easier to spot and fix quickly, rather than finding that when you jump in and turn the key, nothing happens.

Also, don't forget the insurance requirements and expenses along with the licensing requirements and expenses for self propelled CPs.

One of the often-overlooked problems is finding a place to store the CP. A school bus based CP offers plenty of interior room for the operators, but it can take up all of someone's driveway for storage. The storage problem is often a trade off between security and accessibility. A CP that is locked in someone's garage while they're gone to Florida for the winter doesn't provide much service. On the other hand, a CP that's parked in front of someone's house with the keys in it probably won't be there very long. So, a balance is needed between the ability to park the vehicle in a secure location, yet allow authorized personnel access to it if the primary person isn't available.

One of the cost issues that factor into the design of a vehicle is whether it is being designed and custom built by a company, or whether it is being retrofitted by the users. The first CP that the Georgetown/Scott County DES had was a converted bookmobile that the library had surplused because of its age and maintainability. It was a simple matter to rip the bookshelves out of the back of it and install a bench with radios bolted to it. A second battery was easy to install and provided additional power to operate the radios. The total cost for the entire vehicle, including radios and other equipment was under \$3,000!

When the agency outgrew the bookmobile CP, it was decided to purchase a newer and larger vehicle. Specifications were drawn up and requests for quotations were sent out, and the responses all came back in the mid six-figure range! Several companies, which build recreational vehicles were interested in doing the job, but because it was a specially constructed vehicle, it couldn't be done on the regular production line. And, specially produced vehicles are much more expensive than production vehicles. Plus, there are various federal regulations that vehicles have to meet, which drive the cost up dramatically for custom vehicles (e.g., Think about things like crash tests.). Thus, the decision was made that instead of purchasing a custom designed CP, that instead a regular production recreational vehicle would be purchased, and portions of the interior would be removed and replaced with the radio equipment. As a result of this, the price for the vehicle was approximately an order of magnitude less.

[1] The manufacturer that the vehicle was purchased from did agree to leave the bed out of the back as a concession to what the group wanted.

The point that I'm making is that it may be more cost effective to purchase a standard production vehicle and modify it for use as a command post rather than having a manufacturer custom manufacture one, even if the group's funding allows the purchase of a new vehicle. Of course, most groups will be restricted to acquiring used vehicles and modifying them to suit their purposes.

### On the Amenities

Tony, in Part 1 Commented, "...the frequently overlooked disadvantage is that such facilities too often serve as a beacon to invite others to loiter around your vehicle, causing your operation to eventually resemble a break room or lounge."

One of the other problems with incorporating rest room and kitchen facilities is that they require extra maintenance. Few people like scrubbing toilets, emptying sewage tanks, or even cleaning out the refrigerator. But, unless these activities are regularly done, you end up with bathrooms that are too smelly to use, sewage tanks that are overflowing, and refrigerators full of fuzzy green things running around that no one can identify, even if they could catch them. Plus, the sewage tank must be winterized, and any fresh water tanks must be kept full of fresh water and not allowed to freeze. Thus, it may be better to stash an empty cooler and water jug in the CP that can be filled with ice and snacks while heading to a scene. And, it may be better to stash a couple of packages of toilet paper, in moisture and humidity proof baggies, rather than trying to design bathroom facilities into the CP.

There is always either too many or too few people in the CP. Either enough operators won't be present, especially in the early stages of the operation, or too many will show up, especially in the middle of the operation. Thus, some thought needs to be given to allowing enough space to accommodate multiple operators, but the layout should also be usable by one operator. And, consideration should be provided for allowing the excess personnel to relax in a location away from the operating positions. This can be accomplished by including a couple of extra chairs that can be taken outside of the vehicle. It may also be desirable to include an outside canopy or other device to shield people from rain or other inclement weather.

Attention should be paid to providing a comfortable operating position, as well as a comfortable, out of the way place for spare operators to rest. Adrenaline will power the operations crew for the first hour or two, caffeine will power them for another couple of hours, and then pain will power them through another few hours, but after that, numbness sets in. Thus, to prevent the operations crew from becoming zombies, provisions need to be made to allow them periodic rest breaks, to satisfy their biological needs (hot coffee, sandwiches, etc.), and to provide as much comfort as possible. Air conditioning systems are wonderful for summer events if the power can be supplied to operate them. Fans may suffice otherwise. Heating systems are almost essential in winter.

### Dave's thoughts on Power Sources

Twelve-volt systems are good since most of the radios that will be installed in a CP will function from twelve volts. This allows the option of using storage batteries to power the equipment, an engine powered alternator, or commercial power via power supplies.

It is impossible to pay too much attention to lighting. Darkness can completely change the scenario where the CP is being used. Not only are interior lights necessary so that the operators can see what they are doing, exterior lighting is usually required, too.

Some thought may be given to providing automatic switch over facilities so that if the commercial power drops out (either because of a natural disaster, or because some fool tripped over the power cord to the vehicle), the radios, lights, and computers continue operating from a battery. It is also worth installing lights to indicate which supply the equipment is operating from, even if an automatic switch over isn't being used. It's very easy to put the equipment on a battery supply when the CP is first being activated, but then to forget to switch the equipment over to commercial power once a power cord has been attached. It's no fun to have a radio quit at an inopportune time because the battery it was operating from went dead because the operator forgot to switch it over to commercial power.

When using batteries to supply power to the equipment, it is usually good to have these batteries separate from the battery used for starting the vehicle. It is very embarrassing to use a

CP from battery power for a few hours, and then, upon realizing that the engine needs to be started to charge the batteries, to find that there isn't enough power in the starting battery to crank the engine. Many places sell various types of transfer switches or diode systems to allow multiple batteries to be charged from the vehicle alternator, but which will prevent the charge from being drained off of all of the batteries at once. And, even with these precautions, it's also a good idea to install a set of jumper cables in the vehicle.

Redundancy is good in every aspect of the design. It's quite possible for any piece of equipment to suddenly fail. And, if that piece of equipment happens to be critical to the operation of the CP, then it has just turned from an asset to another piece of junk hampering the operation.

One concern with using the vehicle's alternator for a power supply is that this requires running the engine on the vehicle. This means that exceptional attention must be paid to the exhaust system since it's incredibly easy to create a carbon monoxide poisoning scenario. Any exhaust system leaks must be fixed, and consideration should be given to where the exhaust pipe points, and even where the wind is coming from and how the vehicle will be oriented when in operation.

The same exhaust problems are possible for generators, too, especially if permanently installed on the vehicle. However, one option for a generator-based system is that it may be possible to physically remove the generator and locate it remotely away from the operating position. Not only will this lessen the chances for carbon monoxide poisoning, but it may also alleviate some of the noise near the operating position.

With any gasoline operated equipment, extended operations will require refueling periodically. Careful consideration must be given to where any fuel is stored. Gasoline vapors are extremely explosive, and it is not conducive to good operations to cause your CP to explode on the scene!

If consideration is given to using the vehicle's alternator for supplying power to the CP, consideration should be given to the thermal aspects of the engine operation. Some vehicles, if allowed to idle for an extended period of time, may tend to overheat. Sometimes, it can be beneficial to raise the hood to allow excess engine heat to be dissipated. However, it's also a good idea to place a warning sign in the driver's position so that no one attempts to move the vehicle with the hood unlatched and partially raised (Don't laugh: it happens more than you'd imagine!). Also, some vehicles when running at idle speeds may not produce enough power from the alternator to keep the batter fully charged.

If a permanently mounted generator is to be used to power the CP, consideration must be given to the thermal aspects of the generator installation, which, unfortunately, often are counter to the acoustical aspects of the installation.

#### Antenna Considerations:

Vehicle mounted antennas are a great way to allow the CP to become operational quickly, since one of the biggest problems when a CP is initially deployed is in getting enough operators to make it operational. However, vehicle mounted antennas have a few problems. The CP may be restricted as to where it can be located, and this may be in a location, which is poor for radio communications because of altitude considerations. A remote antenna system, complete with 40 feet of mast pipe, and a hundred feet of coax can vastly improve the communications efficiency of the CP. The drawback, though, is that it requires time and people to erect.

One alternative is to provide a push up, or crank up tower on the CP itself. Of course, this can turn into a mechanical nightmare, especially if the vehicle isn't securely stabilized. It's no fun when a slight breeze causes the CP to be turned over on its side.

Another issue with antenna placement also involves the choice of equipment to be placed into the CP. Since the roof area of the CP will be quite limited, the roof-mounted antennas will necessarily be located quite close to each other. Since most modern radios produce fairly high amounts of power, the possibility is present that the front ends of the various radios may be overloaded. There is little point in designing a CP with provisions for two operators if the radios are desensed by each other so that only one operator can communicate at a time. Thus, it's important to consider how immune the various radios are to front-end overload. Band filters may help some if the radios are on different bands.

During an operation, the number of people and agencies on the scene are truly staggering. What's even more incredible is that almost all of these agencies have no way of communicating with each other directly. Thus, the Tower of Babel pales in comparison. Therefore, it makes sense to use the CP to facilitate communications with the various agencies and groups on scene. Of course, legal requirements may restrict some aspects of this, but the FRS idea provides at least one common communications channel.

In any case, it is essential that any equipment distributed be clearly labeled as to who owns it and how it should be returned after the event. While almost every emergency services worker is honest, it's exceptionally easy to accidentally walk off with a piece of equipment. And, labeling the equipment with the owner's name and address makes the return much more likely.

Of course, as with any handheld radio equipment, extra batteries are a must. A batch of FRS or other radios won't be much good after the batteries run down. Thus, provisions need to be made for either replacement batteries, or a way to rapidly recharge rechargeable batteries.

Quoted from Part 1 by KC4JTV, "Blocks, jack stands, or wooden cribbing should be provided to support your unit and eliminate most of this unneeded movement. A small floor jack will make this job less taxing, as it provides a substantial mechanical advantage over other types and can be operated while standing."

This is a good point that is often overlooked by most groups. Not only will the continual rocking motion be annoying, any unlevelness in the vehicle will tend to increase the danger of hot beverage spills. Plus, it can be incredibly tiring to have to continually fight against the force of gravity on a sloping floor that is trying to push you either into or away from the operating bench.

Quoted from KC4JTV in Part 1, "The eventual layout of your command post will evolve with its use; this should be expected and planned for. Don't be discouraged if a design that sounds and looks good on paper fails in actual use, as it is nearly impossible to forecast the demands that actual deployment will place on your equipment. After the initial use of your command post, preferably in a non-emergency situation, critique its performance. Don't be afraid to modify it to suit the needs of your own group, after all it is your home away from home."

This is the best piece of advice in the whole article. There are many of us here who have used CPs, and I'm sure that we're all willing to discuss our experiences and offer our expertise. However, every group's requirements and expectations are slightly different, and what works well for one group may be completely unusable for another. Unfortunately, some of these problems will only become apparent after the CP has been built and used for a while. Thus, the ability to rework it to improve it is an absolute must.

Plus, another design consideration may be to start small, and expand and improve the CP after some experience has been gained. Not only does this allow the group's experience to be factored into the improvements, it also allows the cost to be spread over a longer period.