Guidelines for the Design and Construction of Mobile Command Posts and Similar Emergency Response Vehicles

Prepared for Emergency Preparedness Canada

by

James A. Hanna, M.Sc.

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[also available in French and Spanish]

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INTRODUCTION

BACKGROUND

The *Guidelines for the Design and Construction of Mobile Command Posts and Similar Emergency Response Vehicles* were developed to provide assistance to agencies in designing, procuring, or renovating such vehicles.

Historically, the development of such vehicles was based solely on perceived or identified needs. Distances and finances, particularly in smaller communities, often precluded visits to examine at first hand existing vehicles. As a result, the opportunity to benefit from the experiences of others was often limited. In addition, when agencies developed such units for the first time, previous local experience was often non-existent.

INTENT

The intent of these Guidelines is to offer to designers of such vehicles a base standard for reference during the developmental process.

It is recognized that functions and uses, as well as the operational environments of such vehicles, are varied, and that no guidelines can be totally definitive, nor applicable in all instances.

CLIMATIC CONSIDERATIONS

These Guidelines are intended to be applicable to the broadest range of climatic and environmental conditions common to Canada, with the exception of far northern/Arctic operations. Extreme tropical temperatures, characteristic in some international missions, likewise place special demands on vehicles and equipment.

If vehicles are intended or contemplated for use in areas of extreme temperatures, persons knowledgeable in such applications should be consulted during the preliminary design stages.

SCOPE

These guidelines are primarily intended for mobile command posts and similar emergency response vehicles. While a number of sections may be applicable to other emergency vehicles (e.g. ambulances, fire pumpers) these are not the prime focus of this document.

DEVELOPMENT OF THE GUIDELINES

As part of the overall developmental process, a number of visits to sites were made, to examine existing vehicles and interview designers and users.

Three geographical areas were identified for site visits: two in Canada (south-central Ontario, and central and eastern Nova Scotia), and one in the United States (southern Maryland).

The areas were selected as offering a wide range of vehicle designs, types, functions, and agencies, as well as geographical differences.

Thirty-five vehicles were examined, and staff interviewed. Chassis types included school buses, transit buses, highway coaches, office trailers, house trailers, tractor-trailers, custom motor homes, vans, cube vans, cab-and-chassis, and modular units.

User agencies included fire departments, police departments, ambulance services, governments at various levels, volunteer groups, and industry. Uniqueness, and variety of body style, design, and use were the principal criteria for selection. Several of the vehicles were recommended for review by others knowledgeable in the emergency preparedness field.

USE OF THE GUIDELINES

The Guidelines are intended to be used both in the conceptual and design stages, as well as incorporated into tender specifications where applicable.

The various indicators have been presented under a number of broader-based subject areas; however some criteria may fall within two, or more, categories. "Lighting", for example, is addressed under " Interior" relative to placement, and under "Electrical" for wiring. This has been so structured to avoid re-statement under several headings. As a result, specific criteria should not be referenced in isolation from the Guidelines in total.

TERMINOLOGY IN THE GUIDELINES

In some instances, criteria are identified as "for consideration," with the intent that the user evaluate these relative to specific local requirements.

Where the experience of others was clear, "should" has been applied, suggesting compliance unless a specific local circumstance or application dictates otherwise.

"Must" has been used, mostly in safety-related aspects, where deviation could well have significant health or safety implications for users.

TECHNICAL EXPERTISE

Due to the complex and technical nature of communications hardware and the provision of electrical power, it is highly recommended that persons with the appropriate specialized knowledge in these areas be involved in the design process, as well as ongoing monitoring during the construction phase.

PRE-TEST OF EQUIPMENT

Where possible, every effort should be made to pre-test equipment (e.g. generators, heaters, etc.) prior to selection/installation to ensure the component will function as envisioned. This is particularly applicable to products with which the user has had no previous experience (i.e. in other vehicles, etc.).

IMPACT OF FEDERAL-PROVINCIAL LEGISLATION

Where any conflict in these guidelines occurs with federal motor vehicle standards, or provincial/territorial legislation relating to motor vehicle traffic, such shall be resolved in favour of the applicable legislation.

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GUIDELINES

1. INITIAL CONSIDERATIONS

Prior to developing specifications, the following factors/decisions should be addressed:

1.1 Funding

Funding, grants, cost-sharing and the relative proportions and limitations of each contributor must be established and documented.

1.2 Continuity

There must be documented on-going financial commitment for maintenance, repairs, and future upgrading of the vehicle.

1.3 User Agencies

Input on minimum operational requirements should be obtained from each user agency.

1.4 Management Structure

The management structure/system (e.g. Emergency Site Management, Incident Command System, etc.) to be employed by each user agency should be established, as it may have implications on the interior layout.

1.5 Usage/Function

There must be consistency of understanding as to the specific use, control, operation, and activation of the vehicle, and agreement by all user agencies, to ensure proper design criteria.

1.6 Readiness

A designated agency must be responsible for daily upkeep, readiness, dispatch, and movement of the vehicle to the incident site.

1.7 Mode of Response

The mode of response must be established. This will impact upon the provisions of emergency lights and siren, as well as whether non-emergency personnel will operate the vehicle.

1.8 Motive Power (Fuel)

Local availability (in all areas to be serviced) of the intended motor fuel (e.g. gasoline, diesel, propane) should be established.

1.9 Range

The potential operational range of the vehicle, relative to the availability of the selected fuel, should be considered in determining optimum fuel tank size.

1.10 General Functions

The general function(s) of the vehicle should be identified, as these will impact upon design criteria. These include:

- communications/dispatch
- command and control
- decision making and planning
- conference
- first line response.

1.11 Amenities

The need to include the following amenities must be considered:

- toilet; wash basin; shower
- running water; sink
- stove/microwave oven
- refrigerator/freezer.

Where these are not identified for inclusion, alternate supply of these amenities, on a 24-hour basis, should be established, particularly if the vehicle will operate:

- for protracted periods, and/or
- in a non-urban setting.

1.12 Storage

Storage (garaging) of the vehicle should be considered. Where indoor storage is contemplated, vehicle dimensions, including roof-mounted lights, air conditioners, antennas, etc. must fit existing space and doorways.

Where outside storage is contemplated, engine block heaters, shore power connections must be planned, as well as the impact upon on-board water systems and holding tanks. Effects on sensitive electronic equipment must also be considered.

Proper security must be in place.

1.13 Roof Platform

If roof-mounted platforms or catwalks are anticipated, a reinforced roof design must be sufficient to hold personnel and/or heavy equipment; this loading factor must be determined and specified.

1.14 Roof Design

A curved roof design, which may offer increased roof strength, can reduce the storage space of interior cabinetry mounted near the ceiling.

1.15 Winch

If a winch is contemplated, power and structural mounting must be considered.

1.16 Industrial Grade

"Heavy-duty" or "industrial grade" should be specified in all applications, i.e. cabinets, hinges, fastenings, flooring, tabletops, etc. Standard recreational vehicle materials may not withstand the heavy use to which the vehicle may be subjected.

1.17 Exterior Doors

The number of access doors (other than the driver's door) should be considered. One-door access will permit better control of unauthorized entry, but will increase the disruption caused by the entry and movement of personnel to other areas of the vehicle.

1.18 Vehicle and Component Selection

A vehicle should be selected which will have readily available parts for repair and maintenance, as well as access to service facilities, to reduce down time. This applies equally to interior design components, as well as to electrical and communications hardware.

1.19 Consistency in Components

As far as is feasible, all interior parts should be of like design, to reduce the number of spare parts and tools needed to ensure readiness. This includes such items as switches, hinges, light fixtures and bulbs, fasteners, etc.

1.20 Exterior Lighting

The role of exterior lighting on the vehicle should be considered – high intensity scene lighting, or merely security for the vehicle. The type, style, and weight of lighting envisioned may impact on roof/sidewall design/strength.

1.21 Vehicle Operators

The intended personnel/agency to operate the vehicle should be considered, relative to the size of the vehicle chosen. Specific training may be indicated. Availability during off hours, appropriate driver's licence, as well as familiarization with emergency response driving, should be considered.

1.22 Vehicle Configuration

Consideration should be given to:

- underbody ground clearance
- wheelbase/turning radius
- angle of approach (Fig.1)
- departure angle (Fig.1)

relative to the anticipated operating environment.

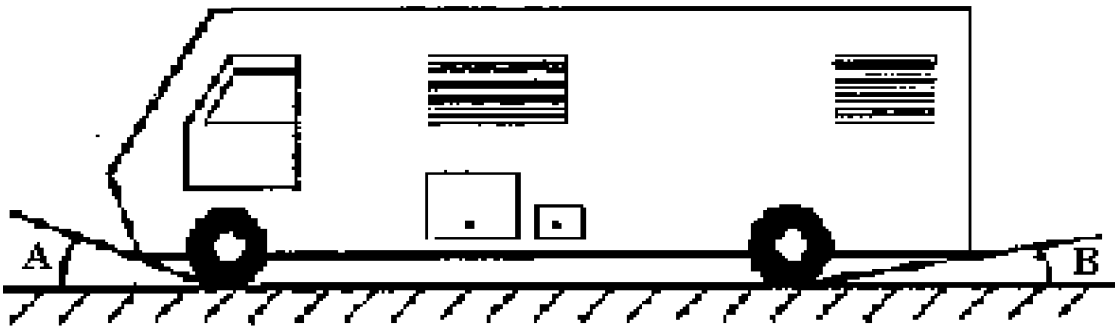

Figure 1: Angles of Approach (A) and Departure (B)

1.23 Primary Operational Environment

The operating environment of the vehicle should be identified, due to its applicability to vehicle design/configuration. Typical operational environments include:

- Urban - within large metropolitan area
- Urban - within small to mid-size urban area
- Rural - linking two or more small communities
- Highway - significant highway usage
- Highway - linking two or more small communities
- Airport area - paved areas
- Airport area - paved and off-runway areas
- Off-road usage

1.24 Legislated Restrictions

Preliminary designs should be reviewed to ensure compliance with provincial or territorial highway traffic legislation applying to vehicle

- height
- width
- gross weight
- length.

The implication of driver's licence legislation should be considered, as many potential drivers may not be licensed to operate a vehicle of the envisioned dimensions.

1.25 Manufacturer's Limitations

Preliminary design should ensure:

- anticipated gross vehicle weight does not approach the manufacturer's Gross Vehicle Weight Rating (GVWR) for the chassis selected
- manufacturer's warranty is not voided by the intended use.

1.26 Power-to-Weight Ratio

Deliverable power, appropriate to the total weight of the vehicle, must be considered to ensure adequate performance.

1.27 Conversion Company Selection

Any body builder or automotive conversion company to be used must be authorized to affix the National Safety Mark and provide a Statement of Compliance under the *Motor Vehicle Safety Act* (Canada).

1.28 Smoking Policy

A smoking policy should be developed and appropriate signs displayed in the vehicle.

2. CHASSIS/BASE VEHICLE CONSIDERATIONS

The following should be considered relative to the specific body/chassis design of the base vehicle.

2.1 Custom Box on a Cab and Chassis

2.1.1 The box should be designed to be remounted on a new chassis.

2.1.2 The box should be designed (e.g. structural, mounting members, etc.), to be compatible with major North American vehicle manufacturers' chassis, to permit ease of re-installation should the cab and chassis be replaced by that of another manufacturer.

2.1.3 Wiring between the cab and box should terminate in connectors or a junction box, not wired straight through, to avoid cutting and splicing, or total re-wiring, when the box is remounted.

2.2 School-type Bus

2.2.1 The school-type bus body should be specified for "adults." This usually available option will provide increased interior head room height.

2.3 Semi-Trailer

2.3.1 A trailer designed as a reefer (refrigerated trailer) should be considered due to its extra insulation.

2.4 Trailer or Other Non-powered Design

Consider:

2.4.1 The availability of a power unit especially during off-hours.

2.4.2 The availability of drivers who are experienced in articulated vehicles and who have the necessary drivers licences.

2.4.3 The ability to recall the power unit (by radio, etc.), should it be concurrently committed to other duties.

2.4.4 The proximity of the power unit to the trailer location, relative to severe weather which blocks roads, etc.

2.4.5 With a trailer, generally, the height is such that a clear view through windows is possible over the heads of personnel outside; however, this height also creates a problem in face-to-face communications through windows when this is desirable.

2.5 Fibreglass Body

Where a fibreglass, rather than metal, body is contemplated, additional roof inserts for a radio antenna ground plane may be required.

3. EXTERNAL CONSIDERATIONS

3.1 Fuel and Exhaust Systems

3.1.1 The gas cap should be tethered to prevent loss, and the cap or access door should be lockable.

3.1.2 An explosion-resistant fuel tank should be considered.

3.1.3 The appropriate fuel required for the various tanks should be identified on or adjacent to the respective filler pipe.

3.1.4 The exhaust/tail pipe(s) for vehicle engine and generator must extend beyond the body of the vehicle.

3.1.5 Engine and generator exhausts should be routed so as not to terminate near doors, windows, or air intakes.

3.1.6 Tail pipe and exhaust pipes should not exit the body of the vehicle immediately below fuel filler pipes.

3.1.7 Vehicle fuel tanks should be positioned so as to be protected from impact damage.

3.1.8 Auxiliary fuel containers, to power on-board stoves, refrigerators, etc., should not be mounted in an exposed, unvented, or unprotected location.

3.2 Insulation

3.2.1 The vehicle underbody, and generator compartment, should be properly insulated to inhibit the entry of fumes into the vehicle.

3.2.2 The vehicle should be as air-tight as possible. Apart from climatic considerations, protection will be enhanced should the vehicle be caught in a toxic cloud due to an unexpected wind shift during a hazardous materials incident.

3.2.3 Soundproofing should be considered

- against outside noise
- against inside noise (e.g. sound absorbing).

3.3 Doors and Windows

3.3.1 Windows provide for natural light, but compromise wall space for map placement, white boards, etc. The installation of tracks or clips on the interior, allowing boards or charts to be placed over windows when additional wall space is required, should be considered.

3.3.2 Natural light in daytime is usually preferable to artificial light. Consideration for ceiling skylights, that can double as fresh air access and/or emergency escapes is indicated, as these can admit light when side windows must be curtained for privacy. Incorporation with air circulation fans can assist in air movement, particularly in vehicles without air conditioning.

3.3.3 Latches to hold exterior doors in the open position prevent wind damage.

3.3.4 Where two (or more) areas exist (e.g. communications, conference, etc.), an external door opening directly to that area will avoid traffic through one section as the sole access to the other.

3.3.5 Roof access ladders should be firmly affixed to structural members, and of a non- slip step design. Safety hoops should be considered.

3.3.6 Roof platforms should be securely attached to structural members, and designed to accept the intended weight of personnel and equipment.

3.3.7 The decking surface should be non-slip and non-reflective. Fixtures should be designed to eliminate potential tripping hazards.

3.3.8 Where roof activity is anticipated, swing-up stanchions for the attachment of cable or ropes, can provide a safety railing.

3.4 Canopies

3.4.1 External canopies, which can assist in outdoor briefings, should be made of fire-proof or fire-retardant materials to protect from wind-borne sparks at a fire.

3.4.2 Where a canopy is deemed desirable, a canopy on both sides of the vehicle will provide flexibility, avoiding the necessity to reposition the vehicle for optimum presentation or necessary access.

3.5 Cabinets

3.5.1 All external cabinets should be watertight, and lockable to prevent loss or theft of contents. All outdoor compartments should be keyed identically, to reduce the numbers and storage of keys, as well as facilitate identification of the proper key, particularly in poor light when lock/key reference numbers are difficult to read.

3.5.2 External compartment locks should be non-protruding and selected to reduce water retention and hence corrosion, and possible freeze-up in cold weather.

3.6 Lighting

3.6.1 Lights in step-wells, as well as adjacent to outside steps, should be considered for safety.

3.6.2 External lighting, similar to side marker lights on commercial vehicles, along the length of the vehicle should be considered. As an alternative, retro-reflective side/rear markings can enhance visibility, although such may be contra-indicated in vehicles used for law enforcement/surveillance activities.

3.6.3 Reversing lights near the front of the vehicle, commonly termed "docking lights", which illuminate the adjacent backing path, and supplement the regular rear-mounted back-up lights, may be indicated, particularly for long vehicles (Fig.2).

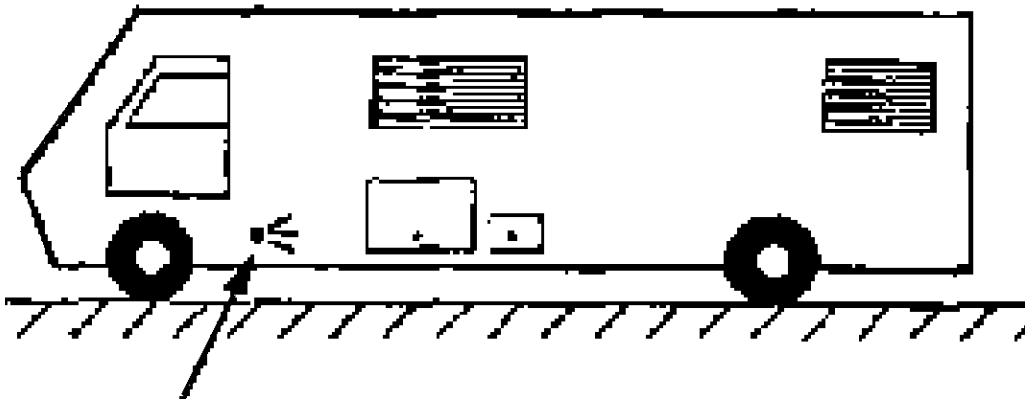

Figure 2: Docking lights

3.7 General

3.7.1 Cable ports, with covers, inside and out, and without sharp interior surfaces or edges, can provide ease of entry of cables (power, telephone, etc.), for connection within the interior of the vehicle. Such (a) port(s) can also facilitate temporary antenna hookups without running cables through doors, windows, etc.

3.7.2 Tow hooks, designed and mounted to withstand necessary stress, should be provided front and rear. The design, positioning, and strength of the vehicle bumpers should permit use of the hooks without damage.

3.7.3 On particularly long or large vehicles, a push-button panel at the rear, connected to the driver's cab, can indicate whether the driver is to move ahead, stop, or reverse. This can assist manoeuvring in tightly restricted operational areas. The compartment must lock to prevent misuse.

3.7.4 External rope tie-downs, mounted to the sides of the vehicle can facilitate the attachment of rope barriers, barrier tape, etc., to define a restricted area containing the vehicle.

3.7.5 Where spare-tire storage is to be located within the vehicle, proximity to an external door is desirable to avoid moving a wet or muddy wheel through the vehicle during the tire-changing process.

3.7.6 Manufacturer's tire inflation pressures should be on a label adjacent to each wheel.

3.7.7 Stairs should have high-visibility striping at the edge of each step.

3.7.8 A minimum number of keys should be required to operate all aspects of the vehicle. A maximum of five (5) is recommended.

- all doors
- ignition
- all exterior compartments
- all interior cupboards
- interior security cupboard (purses, evidence, etc.).

Even if multiple keys are coded to locks, the correct key can be difficult to locate in poor visibility.

3.7.9 Waste and water intakes on the exterior of the vehicle should be clearly marked to avoid error.

3.7.10 Stabilizing or levelling jacks should be considered to prevent vehicle motion when stationary.

4. INTERIOR CONSIDERATIONS

In the development and design of the interior, the following should be considered:

4.1 General

4.1.1 In a multi-agency use vehicle, communicator positions should be established in the early stages to ensure proximity to any needed resource material, as well as other operators with whom frequent contact is likely.

4.1.2 Where a vehicle is used by several agencies separately, containerization of each agency's specific equipment can be stored at the vehicle garage, and loaded prior to response if space on the vehicle is limited. Multi-use supplies would continue to be stored on the vehicle.

4.1.3 The layout of the vehicle should be such that:

- radio/telephone communicators are closed off from the planning/control functions to limit noise and other distractions,
- the above are separated from an equipment area, if the vehicle carries items continually in demand from field personnel,
- these items, if carried, are stowed, wherever possible, in external compartments to reduce interruptions of the command and communications functions.

4.1.4 Installation of communications and computer equipment in particular should be non-permanent, due to the current rate of technological change relative to the anticipated longevity of the vehicle.

4.2 Cabinets, Desks, and Work Surfaces

4.2.1 A writing desk or surface mounted in front of the front passenger seat (with an "L-shape" or wrap-around in motor-home style vehicles without a passenger door) can provide an additional work station. The edges of the desk surface must be padded to reduce impact injuries.

4.2.2 Pull-out or lift-up writing or work surfaces (other than those which must be fixed in a communications area) can provide flexibility when working surfaces are required, yet can be stored when additional seating or standing room is necessary.

4.2.3 Acetate sheets, or hinged plexiglass on walls and tabletops, under which maps or charts can be placed, permit marking of tactical information while keeping the documents clean for future operations.

4.2.4 Counters should be designed and constructed;

- of lighter colours, to reflect available light
- of a non-shining surface to reduce glare
- of stain, mark, and chip resistant material
- with rounded, rather than right-angled corners
- of industrial, rather than recreational-vehicle-grade material
- of a surface that can be wiped clean.

4.2.5 Desks and similar working surfaces should be:

- at a proper working height, relative to supplied chairs
- designed with a knee-well, which should accept the intended chair, both to reduce operator fatigue, as well as for space efficiency.

4.2.6 Where communicators are not across the rear of the vehicle, positions facing parallel to the direction of travel avoid chairs obstructing the aisle, particularly on narrower vehicles, or where positions are placed on both sides of an aisle.

4.2.7 Counters and work surfaces should be designed to bear human weight, should they be used (although not intended) for ad hoc seating.

4.2.8 Consideration should be given to mounting radios, telephones, etc., on the wall or vertical surface immediately above the relevant communicator's position, to maximize the working counter surface. The controls should be within comfortable reach of the seated operator.

4.2.9 Where telephones or radios are required (permanently or occasionally) on a centrally-mounted table, wiring run through the sub-floor and up the table legs to (a) small hole(s) in the surface, can avoid wires being run across the floor, over seats, etc.

4.2.10 Large writing pads, cut to the exact size of working surfaces, can provide a ready writing surface, while protecting counter tops.

4.2.11 A pre-positioned:

- telephone jack
- power outlets, 110 and 12 volt
- light

at each work position will increase flexibility and reduce the number of cords and wires.

4.2.12 A storage cupboard for wet rain gear, boots, and winter coats should be considered, where space permits.

4.2.13 A securely locking cabinet, for the wallets and other valuables of staff, as well as securement of evidence (law enforcement application) or drugs (medical application) should be considered.

4.2.14 Latches should be sufficiently strong to withstand impact by shifting contents during transit, and should be recessed or have low profiles to prevent injury or snagging.

4.2.15 Cupboards and cabinets should be designed for the items they are intended to house, to ensure optimum space utilization.

4.2.16 Cabinets for 3-ring binders and other manuals should permit these to be stored vertically for ease of removal.

4.2.17 Contents of cabinets should be identified on the door by:

- a list of contents
- the subject or category of contents, or
- by a number keyed to a wall-mounted index.

Lists should be visible in poor light and from a reasonable distance.

4.2.18 Reference material required for a particular incident (e.g. hazardous materials) should be stored together.

4.2.19 Flat, rather than rolled maps can save space, as well as facilitate working from a document that does not need the corners anchored.

4.2.20 The inside of drawers used to contain fragile equipment should be lined with foam rubber or similar energy-absorbing material.

4.2.21 All moveable objects should be secured in transit, both to protect occupants as well as vulnerable items. Consider bungee cords, velcro bases, lips on shelves, tethers to wall, etc.

4.2.22 Adjustable/removable shelves can permit flexibility to meet changing needs. These must be anchored to prevent movement in transit.

4.2.23 Fixed lips on book shelves to prevent manuals and binders from falling during vehicle movement, effectively limit the usable height. Spring-loaded, or hooked lips, or other means of content restraint should be considered.

4.2.24 Shelf lips should have no sharp edges, especially if metal. Rolled metal is preferable to a box design, as the latter reduces shelf depth.

4.2.25 "Cross-through" cabinets capable of being accessed from both the inside as well as the exterior may provide an entry for carbon monoxide (from engine and/or generator exhaust) into the interior of the vehicle.

4.2.26 Compartment, particularly exterior, doors, that are fixed at a maximum of 90° upon opening laterally can inhibit using two persons to remove heavy equipment.

4.2.27 Cupboards mounted above shoulder height with lift-up doors should:

- have mechanisms to retain in the open position
- be fixed in the open position at such an upward angle as not to present a hazard to face or eyes.

4.2.28 Cupboards and cabinets should be designed to avoid waste space. Positioning in the vehicle should avoid leaving small areas of floor space which cannot be used for other purposes. (This often occurs when stock, rather than custom cupboards are utilized.)

4.2.29 Carpets in underbody compartments are not recommended if heavy, wet, or dirty equipment is to be stored or returned there.

4.2.30 Lights should be considered for exterior cabinets, as well as interior floor level cabinets if switches, wiring, hook-ups or other detailed activity within the cabinet is necessary. Lights should switch off automatically upon door closure to prevent inadvertent battery drain, as well as having a manual switch if a cabinet must remain open.

4.3 Flooring

4.3.1 Flooring should be selected that is:

- of a dark colour, to avoid showing dirt, marks, or scuffs
- of a non-slip design, especially when wet
- a durable, heavy-duty industrial type, rather than carpet, to withstand wear and avoid stains
- without small, deep, close grooves that retain dirt and hinder cleaning.

4.3.2 Where particularly heavy, wet traffic is anticipated, removable ribbed rubber flow-through mats running the length of the vehicle, over the flooring, may provide an easily cleaned, non-slip surface.

4.3.3 Where one-piece flooring can be carried up the wall for a distance of four to six inches, water cannot enter at the wall/floor joins, and cleaning is facilitated.

4.4 Steps

4.4.1 Step-wells encroaching on/into the floor area should be guarded on the sides with railings (or by the design of adjacent, abutting cabinets).

4.4.2 Highlights around the step-well edge should be considered.

4.4.3 If the door is used infrequently, a securely fitting cover, flush with the floor, can increase floor space and avoid falls.

4.4.4 Steps should have:

- handrails, and
- sufficient step depth (front to back) to safely accept a large boot.

4.4.5 Open grille patterns, common on exterior steps, should be avoided as such can trap small-heeled shoes.

4.4.6 Steps that are removable during transit should store underneath the vehicle, rather than being placed within the vehicle.

4.4.7 Electric or manually retractable steps must be designed to inhibit rust or corrosion damage.

4.4.8 Electrically operated steps must have a fail-safe override to prevent inadvertent deployment in transit.

4.5 Walls

4.5.1 Sound-deadening carpet, particularly of the type used in recording studios, should be considered for the walls of high noise areas.

4.5.2 "Clip-strips," velcro, or other fasteners above windows can provide for the temporary display of additional maps, etc., during an operation.

4.5.3 Magnets (metal surface vehicles), velcro, or clips mounted on the exterior of the vehicle to secure maps, can facilitate outside briefings.

4.5.4 Padded bolsters above low passageways, doors, and openings should be considered to avoid head injuries.

4.6 Lighting

4.6.1 Lighting intended for counters, working surfaces, and display boards should be directed at the surface and shaded from operators.

4.6.2 Lighting (particularly neon tubes) should be protected from breakage. Incandescent lights should have impact-resistant lenses that will not melt or distort from the heat of extended usage.

4.6.3 Light fixtures should be low profile (or recessed with adequate ventilation) and free from sharp corners.

4.6.4 Shielded lights above display boards can avoid shadows created by lights mounted only on the mid-line of the vehicle's ceiling.

4.6.5 Lighting should be designed and directed so as not to:

- reflect in communicator's eyes
- reflect on computer terminal and microfiche reader screens.

4.6.6 Variable levels of lighting should be available in each area, utilizing rheostats, a combination of lights, or different controls.

4.6.7 Softer, night-lights should be considered for periods when activity is minimal.

4.7 Ceiling

4.7.1 All ceiling mounted equipment (air conditioning units, etc.), should have padded perimeters to avoid head injuries.

4.8 Doors and Windows

4.8.1 Exterior doors should be mounted with the hinged edge toward the direction of travel.

4.8.2 Exterior doors should have an additional interior keyless dead-bolt mechanism as a back-up device against inadvertent opening while in motion.

4.8.3 Exterior doors should have opaque glass or blinds, to prevent visualization of interior operations.

4.8.4 Windows capable of being opened should be fitted with

- screens
- latches for security.

4.8.5 Windows (including screens) that open can facilitate the passage of documents, telephone handsets, etc., without the need to enter the vehicle.

4.8.6 All windows, including windows in doors and interior partitions, must be fitted with automotive safety glass to Canadian Motor Vehicle Safety Standards.

4.8.7 All windows in the operational areas should have privacy protection, whether dark-tint glass (often not effective at night), curtains, or mini-blinds, to prevent unauthorized observation of the interior. This includes all windows in a driver's area not partitioned from the remainder of the vehicle.

4.8.8 Where mini-blinds are to be used, vinyl versus metal slates can admit/transmit varying degrees of light in the closed position. Prior to selection, sample blinds should be tested in various light condition to ensure the desired degree of light blocking is achieved.

4.8.9 In law enforcement applications, a one-way glass window in a door separating two interior areas may permit witnesses to view a suspect undetected.

4.8.10 Windows above exhaust/tail pipes should be sealed to prevent entry of fumes.

4.8.11 Where double doors are provided, the appropriate door to be opened first to avoid jamming should be identified with the wording "Open This Door First" or words to similar effect.

4.8.12 Interior doors between compartments that slide into the partitions usually provide better use of space than swinging doors.

4.8.13 Interior full-length doors of smoked plexiglass (or similar transparent material) provide noise reduction and privacy, yet visibility without entering, and a feeling of spaciousness in an otherwise confined environment.

4.8.14 Interior, compartment-separating half-cut doors can permit conversation and passage of documents while discouraging entry.

4.8.15 A "pass-through," either in, or adjacent to, a door can permit the exchange of documents while controlling entry. Such can be utilized either between interior compartments, or to/from the outside.

4.8.16 Where a motor-home style vehicle is contemplated, a driver's door should be considered.

4.9 Emergency Exits

4.9.1 Windows should be designed as emergency escape exits to supplement door(s), particularly:

- where only one door exists in the vehicle
- where door(s) are on the same side of the vehicle (with escape window(s) on the opposite)
- in compartments separated from the area containing the exit door.

4.9.2 Roof-mounted glass areas (for natural light), fresh air vents, etc., should be constructed to permit use as emergency escapes.

4.9.3 Windows and roof hatches intended for emergency escape should contain instructions, on or adjacent, for their emergency operation.

4.9.4 Identification of, and instruction for, emergency escape windows should be positioned in such a way as not to be concealed by drapes or blinds.

4.9.5 When the vehicle is provided with emergency exits (e.g. push-out windows) these should not be obstructed by interior fittings or furnishings.

4.10 Seating

4.10.1 Coverings on seats and chairs should be heavy duty, stain resistant, and easily damp wiped.

4.10.2 Fabric on backrests and seating should be easily removable for repair.

4.10.3 In vehicles without a separated driver's compartment, driver and front-seat passenger seats that rotate 180° can increase seating during operations.

4.10.4 All seats intended for occupancy when the vehicle is in motion must:

- be equipped with an approved automotive seat belt, preferably a 3-point lap/shoulder type
- have seat belts mounted to the structural members of the vehicle, not to the seat or seat mounting
- be equipped with a high back or head restraint
- be capable of being locked in a forward-facing position
- if provided with armrests, be padded on the inner as well as upper surfaces.

4.10.5 Standard office-type clerical chairs must not be occupied when the vehicle is in motion, should be so labelled, and should be restrained from movement.

4.10.6 Fixed-position (non-adjustable) seats at work surfaces can make access difficult, as well as create fatigue when an individual's optimal position cannot be selected.

4.10.7 Where seats will be occupied for a long period (e.g. dispatchers, communicators, etc.), seats permanently mounted to the floor should be:

- equipped with padded armrests
- capable of forward/backward movement

in addition, consideration should be given to:

- adjustable lumbar support, and
- ability to rotate.

4.10.8 Sharp edges and square corners on tables immediately adjacent to seats should be avoided, in favour of rounded and/or padded configurations.

4.10.9 The width of seats (i.e. front to back) should be selected for proper upper leg support and comfort, as well as the proper angle and position of backrests (and headrests, if any).

4.10.10 Where bench seats enclose under-seat storage:

- hinged lids should be capable of being restrained in the open position, to facilitate content removal with both hands
- lids that open rear to front (i.e. hinged at the front) avoid pinches when sitting, although under-seat area is less accessible. Such should be considered for seats running crosswise, thus requiring access from the end of the bench.

4.10.11 If bench seating or couches are being custom-designed, consideration for use as bunks (e.g. length) is desirable if the vehicle is considered for long duration-low periods of activity incidents.

4.10.12 Jump seats should not be spring-loaded (i.e. not return to the closed position when body weight is removed). This is necessary to avoid lower back injuries, should the seat return to the stored position unnoticed when user weight is momentarily removed.

4.11 Heating/Air Conditioning

4.11.1 Where a larger vehicle is separated into compartmentalized areas, separate climate controls in each area should be considered, due to levels of activity, numbers of personnel, etc.

4.11.2 Two smaller heating/air conditioning units should be considered as an alternative to one larger unit, so that basic comfort can be supplied if one unit fails. To the extent possible, each unit should be on a separate circuit.

4.11.3 Vents should be positioned so as not to discharge air directly onto seating areas.

4.11.4 Vents and air returns should not be positioned on the floor, where they become catch-alls for dropped articles, mud and water from boots, etc., but should be wall mounted near the floor.

4.11.5 Air vent grilles should not be located in areas of potential contact damage, e.g. in desk footwells, etc.

4.11.6 Air conditioning, heating, and generator units for the interior of the vehicle should be selected with quietness in operation as a key requirement.

4.12 Sinks, Toilets, and Showers

4.12.1 Where a toilet is provided, the draining mechanism from the holding tank should be selected to avoid the necessity of manually attaching and detaching (and storing) a drain hose to the valve.

4.12.2 Water system holding tanks should be considered early to ensure adequate capacities. Tanks will be required for

- sinks, both kitchen and washroom, and shower, if provided
- waste water, both sink and toilet.

Inadequate capacities may limit flexibility of the vehicle.

4.12.3 Washroom (if included) should be situated near an exterior access door, to avoid outside users traversing the entire vehicle.

4.12.4 Full-length mirrors, commonly standard equipment on recreational vehicle washroom doors, should be removed if supplied to prevent breakage (and injury) when a number of persons are moving about in the vehicle.

4.12.5 In vehicles with minimal space, a small chemical toilet mounted under a lift-up, conventional seat, may provide an option. Privacy (which may be partly resolved with a draw curtain) and odour are possible problems.

4.12.6 Toilet enclosures should be provided with an exhaust fan.

4.12.7 The largest fresh and waste water holding tanks feasible should be considered, to extend range and usage.

4.12.8 A mechanism to heat the water tank and system sufficiently to prevent freezing should be considered, and is mandatory if the vehicle is stored outside, unless a refill and drain procedure is instituted with each operation.

4.12.9 Where kitchen area sinks are provided, flush-mounted covers can provide added counter space when the sink is not in use.

4.12.10 Showers can be desirable, both for personal hygiene during extended or hot weather operations, as well as for decontamination purposes.

An alternative to the standard interior cubicle shower is a hand-held model for use outside the vehicle, with an appropriate external connection. This can be particularly useful for flushing mud, soot, etc., off garments and boots prior to entry.

A run-off catch basin is required if the shower is to be utilized for decontamination purposes.

5. DRIVER'S COMPARTMENT

5.1 Design

5.1.1 The driver's front and side vision should not be obstructed by hardware, or equipment added after the vehicle's manufacture.

5.1.2 Corners and sharp edges of equipment mounted in the driver's compartment should be properly padded to reduce impact injuries, notwithstanding seat/shoulder belts use is anticipated.

5.1.3 A tilt steering wheel should be considered, particularly

- on motor-home style vehicles without a driver's door,
- if the driver's position is intended to be occupied for some function when the vehicle is on site.

5.1.4 Where the driver's seat is capable of 180-degree rotation, a fold-down desk behind can provide an additional work station.

5.1.5 Spotlights mounted on pillar posts, with fixed control handles that extend into the driver's compartment, should be avoided, to prevent impact injuries in a collision.

5.2 Mirrors

5.2.1 Generally, "below eye-level" mirrors are less likely to obstruct vision of cross traffic and pedestrians than other designs.

5.2.2 Where convex mirrors are not part of the original equipment, various positioning should be evaluated prior to permanent mounting, to ensure optimum visibility.

5.2.3 Where convex mirrors are affixed directly to flat mirrors, mounting should be on the outside edge, to permit a non-distorted view when reversing between pillars, etc.

5.2.4 A school bus cross-over mirror on the front corner should be considered for vehicles with a high or large engine hood projection, to provide visibility immediately in front.

5.2.5 Mirrors, including additional convex mirrors, should be positioned to:

- avoid obstruction of any of the reflected view by pillar posts, etc.
- avoid blocking the driver's vision of pedestrians, etc.
- avoid blind spots
- avoid convex mirror interference with flat mirror vision.

5.3 Controls and Indicators

5.3.1 There should be minimal hand and eye travel to any controls or gauges intended to be activated or referenced in transit.

5.3.2 Controls and gauges necessary for in-route usage should be accessible by the driver in the seat-belted position.

5.3.3 All switches and controls intended to be operated while in motion should be mounted at or below the lower edge of the windshield, to avoid interfering with sight-lines during activation.

5.3.4 Any supplementary switches or gauges to the manufacturer's installation should be identified, and be of a recessed, or low-profile design.

5.3.5 Where the vehicle is equipped with emergency lights, these shall give a clear indication to the driver when in operation.

5.3.6 In addition to normal gauges and indicators, the following should be considered:

- a "Door Ajar" indicator
- an "Antenna Mast Extended" indicator (if so equipped)
- a "Personnel on Roof Platform" indicator
- a "Floodlights in Operation" indicator.

5.3.7 The Gross Vehicle Weight should be on a label clearly visible to the driver, particularly if rural roads with restricted bridge capacities, etc., are in the vehicle's response area.

5.3.8 The minimum vertical clearance required for the vehicle should be posted (in metric and Imperial) in clear view of the driver.

5.3.9 A conspicuous "Disconnect Shore Power" label should be clearly visible to the driver, and may be a portable sign which clips to the steering wheel each time the vehicle is energized from an external source.

5.3.10 Where the generator is started prior to proceeding to the incident, an indication should identify this operation in the driver's compartment, particularly with a trailer-style vehicle, when the unintentional shut-down of the generator may go unnoticed.

5.4 Seating

5.4.1 The full travel of the driver's seat should not be prevented by walls, bulkhead, or other impediments.

5.4.2 The driver and front seat passenger positions should be equipped with a:

- three-point seat/shoulder belt assembly of automotive design, properly mounted
- head restraint or high back seat
- supplemental restraint system ("air bag") where available
- mechanism to lock a swivel seat in the forward-facing position.

5.4.3 The interior side of captain's-chair-type armrests should be padded (as well as the tops) to reduce injuries.

5.5 General

5.5.1 Appropriately positioned coffee cup holders should be considered, to avoid the flat surfaces of radios and siren control boxes being used, with the danger of spills into expensive components.

6. ELECTRICAL CONSIDERATIONS

6.1 Batteries

6.1.1 Where battery banks are used, batteries designed for frequent discharge and recharge should be specified.

6.1.2 Where battery banks are used to power radios and similar equipment, an easily switchable alternative power source should be available.

6.1.3 All electrical equipment powered by the vehicle (starting) battery should be wired through a master switch, to avoid battery drain and a no-start situation when the vehicle is idle for extended periods.

6.1.4 A vehicle (starting) battery on trickle charge from another power source (e.g. generator) can ensure starting capability when the vehicle is at a scene for extended periods.

6.2 Generators

6.2.1 A heavy-duty commercial use generator should be considered, rather than a smaller, occasional-use Recreational-Vehicle-type unit.

6.2.2 Diesel generators should be considered because they do not produce carbon monoxide gas.

6.2.3 The generator compartment should be vented in such a manner as to reduce the entry of rain, as well as screened where possible, to avoid entry of insects and vermin.

6.2.4 The generator compartment should be:

- insulated, both for fumes, as well as noise transmission to the inside of the vehicle
- vented to the outside, at a point where fumes will not enter vehicle doors, windows, or air intakes.

6.2.5 Generators should generally not be mounted above the floor line of the vehicle due to noise permeation of the operational areas. The quietest generator available compatible with other needs should be sought.

6.2.6 110-volt capability can be achieved in the vehicle even without a generator or inverter by having a 110-volt system wired in the vehicle and energized from nearby electrical service. This can be a useful backup in case of failure, even in generator-equipped vehicles.

6.3 Fuel (Generator)

6.3.1 A generator fuel tank (with pump) remote from the generator itself will avoid the need to refill a hot generator risking spillage and fire.

6.3.2 A generator and vehicle engine powered by the same fuel can be run off the same tank, simplifying monitoring and refuelling.

6.4 Wiring

6.4.1 Power and extension cords carried should be of bright colour or wrapped at intervals with coloured tape (unless operational considerations dictate otherwise) to reduce people tripping over them.

6.4.2 Where electrical or communications wiring is routed through the back of cupboards, protection from impact damage by heavy objects carried in the cupboards is required.

6.4.3 Cables and wiring to be connected in external compartments should be fed through closable ports on the floor of the compartment. This will permit the compartment door to be closed and locked after hook-up for security reasons, as well as protecting the compartment and connectors from the elements.

Such ports should be near the side of the vehicle (within arm's reach) and away from vehicle and generator exhaust pipes.

Land-line telephone connectors can be handled in a similar manner.

6.4.4 Wiring run through a central conduit, behind an easily removable panel running the length of the vehicle, can facilitate problem tracing.

6.4.5 Where wiring runs between a cab and the operational part of the vehicle, one portal of entry for all wires, with ease of access, should be used.

6.4.6 Vehicle electrical panels should be equipped with re-set circuit breakers, rather than fuses, to avoid unavailability of the correct size fuses during operations. Circuit breakers should be identified as to circuits protected.

6.4.7 Wiring should be easily accessible, both for problem tracing as well as retro-fit. Considerations include:

- colour-coding for various functions
- sufficient slack (or loops) for splicing and servicing
- passage through looms or conduits and avoidance of sharp bends for ease of feeding
- easy access behind ceiling, walls, etc.
- easy access to connectors/joins/splices
- inspection ports at points of connection (e.g. where cables attach to antennas)
- protection by grommets, where wires pass through metal openings
- a readily available wiring diagram.

6.4.8 If work stations are numbered, and all antenna cables, wiring (e.g. telephone) hookups, etc. are similarly identified at termination points in remote sections of the vehicle, connections and problem tracing can be facilitated.

6.5 Connections and Hook-ups

6.5.1 Plug-ins and other connections on the exterior of the vehicle or in compartments should be in a position, and of a type that is:

- easy to access
- easy to see and connect, in darkness, poor light, or inclement weather
- away from entry doors, where cables might create a tripping hazard.

6.5.2 Key items (e.g. communications equipment) should be connected in such a manner that bridging to alternate power sources is easily accomplished.

6.5.3 A voltage protector/monitor should be incorporated at the point of entry of shore power to ensure voltage-sensitive equipment is not compromised by line fluctuations.

6.5.4 Where surge protection is provided for computers etc., on certain electrical outlets, these should be identified separately from outlets not so protected.

6.5.5 Adapters for electrical hook-ups and extension cords should be carried, to facilitate shore power from various sources/types of connectors.

6.5.6 An electrical box, with a "knife switch" can facilitate switching from shore power to generator and vice versa.

6.5.7 A plug-in connection(s) (rather than permanent wiring) of vehicle systems to the generator will permit ease of re-connection to a replacement generator, should the vehicle generator fail during site operations.

A sufficiently long cord will permit the command vehicle to function from an adjacent generator without the necessity of installing the replacement in the generator compartment.

6.6 Switches

6.6.1 Where switches that must be activated are contained within an electrical cabinet, a smaller door, only to access the switches, can be provided within a larger door locked to avoid unauthorized or unnecessary access to connections.

6.6.2 The electrical configuration should be such that should power draw approach overloading, non-essential equipment (previously identified) can be quickly disconnected through one master switch, to reduce electrical load requirements and allow critical systems to continue.

6.6.3 Status controls for generator, power, etc., should be grouped together in one area, for ease of monitoring and operation (heat/air conditioning controls for individual compartmentalization excepted). Ideally these should be in an area of frequent observation.

6.7 Power Outlets and Receptacles

6.7.1 Sliding electrical outlets on a mounted power bar can provide flexibility in equipment placement on counter tops and working surfaces.

6.7.2 All external electrical outlets should have watertight coverings, or dummy plugs on tethers.

6.7.3 Where feasible, outside, 110-volt receptacles should be mounted in exterior cabinets with underbody ports, for energizing external equipment.

6.7.4 Where roof-mounted, portable electrical equipment (e.g. portable floodlights) is anticipated, electrical receptacles near the roof-line will avoid dangling and snagged cords and inadvertent disconnection.

6.7.5 Electrical outlets should not be placed on the floor, or other horizontal surface, to avoid entry of water, spills, etc.

6.7.6 Electrical outlets should not be placed in close proximity to sinks or other water sources.

6.7.7 Ground fault interrupter (GFI) type outlets should be used where feasible.

6.8 Gauges

6.8.1 An alarm and/or warning in the driver's or operational area for low oil pressure, and overheating will alert of generator malfunctions.

6.8.2 A generator fuel gauge in the driver's compartment (or other operational area) will reduce the possibility of inadvertent fuel depletion, and the need to access the generator compartment fuel gauge.

6.8.3 Ammeters, voltage meters, generator status and fuel gauges, etc., mounted in driver's area can permit monitoring (if this position is normally occupied) without disturbing the operational area.

6.9 Lighting

6.9.1 Exterior and interior lighting on rheostats can permit optimal lighting for various requirements.

6.9.2 Light switches in the vehicle should be installed in the same orientation, e.g. "off" and "on" in the same direction.

6.9.3 Scene floodlights should be capable of adjustment from ground level, without the necessity of a ladder and/or roof access. Ideally, all exterior lighting controls would be controlled remotely from within the vehicle.

6.9.4 Interior lights, particularly those that stay on when doors or cabinets are open, should be on a separate switch for deactivation during daylight, to reduce power consumption.

6.9.5 Floor-level lights (for step-wells, etc.) should have impact-resistant lenses, or be otherwise protected from impact breakage.

6.10 General

6.10.1 An electrical engineer, or a qualified automotive electrician, should evaluate power and current needs, to ensure appropriate electrical wiring, systems, and capacity.

7. COMMUNICATIONS

7.1 Radio

7.1.1 Head sets for radios mounted side by side should be considered, for noise reduction. They should be ultra light weight and comfortable for extended use. Earphones for portable radios should also be considered.

7.1.2 Radios with scanning capability may be considered as an alternative to the more conventional scanner.

7.1.3 Consideration to the installation of "Portacoms," which allow other agencies' portable radios to be inserted, provide attached microphone and antenna strength, and can facilitate usage by non-prime agencies.

7.1.4 A choice of hand-set/microphone as well as headset/ speaker for radios can provide greater flexibility, both from a noise as well as privacy perspective.

7.1.5 A standard agency two-way radio should be available in the driver's area for in-transit/response usage.

7.1.6 Appropriate suppressers should be in use to prevent radio interference from on-board electrical equipment.

7.1.7 Foot-pedal transmit switches can free hands of seated communications operators for other uses.

7.1.8 A marine band radio should be considered if appropriate to the area served.

7.2 Telephone - Hard-wire

7.2.1 Consideration should be given to having hard-wire land-line telephone cable fed through an access port for actual connection inside the vehicle, both for weather protection, as well as control and security concerns, rather than connection on the exterior of the vehicle.

7.2.2 Economical land-line telephones, which can be deemed "disposable" and replaced if damaged, rather than more expensive models, should be considered for infrequent use.

7.2.3 Auto or speed dialers can be incorporated to link with the dispatch centres and command vehicles of frequently interacting agencies.

7.2.4 An inexpensive telephone, with a long cord, hard-wired in the vehicle, can provide additional flexibility in the field, as well as for use as a "throw-in" during hostage-taking incidents.

7.3 Telephone - Cellular

7.3.1 Where cost prohibits more than one cellular telephone, (a) remote connections(s) in the vehicle will permit it to be relocated as needs change during an incident.

7.3.2 Cellular telephones should be activated on both cellular networks in the event of network overload or failure.

7.3.3 Multi-line land-line (hard-wired) telephones can often be wired with one line on cellular for backup and increased flexibility.

7.3.4 Labels such as "Not a Secure Line" or similar wording should be placed on all cellular telephones.

7.3.5 A "hands-free" attachment to a cellular telephone in the planning area can facilitate a conference call involving all personnel.

7.4 Television Monitors

7.4.1 TV-VCR capability which can be used to record/playback

- news casts
- closed circuit television of the site
- camcorder filming of the site
- infrared transmission from helicopters

should be examined to ensure optimum capabilities.

7.4.2 A combined TV-VCR unit is the most space efficient and compact. However, if either module fails, the entire unit will have to be replaced. Where units are separate, replacement of either piece is facilitated due to common availability.

7.4.3 A TV monitor on a rotating stand can permit maximum visibility where various seating configurations are in use.

7.5 Computer Terminals

7.5.1 Computer terminals should be positioned to avoid reflection or glare from windows. Adjacent windows should have shades or blinds to prevent back-lighting.

7.5.2 Computerized reference systems should have manual, on-board back-up (i.e. hard copy).

7.5.3 Computer terminals/systems should have voltage surge protectors.

7.5.4 Local Area Networks (LAN), as well as stand-alone computers, should be considered.

7.5.5 An appropriate modem should be installed, compatible with the on-board computer configuration selected.

7.6 Public Address Systems/Intercoms

7.6.1 Where intercoms between areas are installed, hand-set type units can permit reduced noise and confidential communication.

7.6.2 External Public Address (PA) systems should be capable of

- uni-directional broadcast
- multi-directional broadcasts, by the use of rotating speakers, or multi-speakers with individual controls.

7.6.3 Consideration should be given to a driver-operated PA system for in transit, scene-approach use, which can be part of an electronic siren unit.

7.6.4 Where a communications area is separate from the planning/conference area:

- individual speakers for the various radios, which can be selectively controlled, should be considered for the conference area
- individual volume controls for the various speakers in the conference area should be considered.

7.7 Recording

7.7.1 Recording devices for telephones and on-site radios should be considered, as calls will often not pass through, or be monitored by, the regular dispatch centre recording mechanism.

7.7.2 Consideration should be given to microphones in the conference area to tape the decision-making process and discussion.

7.8 Equipment Installation

7.8.1 Where radios are identical to those in the agency's regular vehicles, and are installed in a "quick-connect" manner, a radio from any agency vehicle on site can provide a rapid replacement in case of failure.

7.9 Equipment Carried

7.9.1 Consideration should be given to the provision or installation of the following pieces of communications hardware, whether or not these are to be installed in the vehicle initially:

- way radios (agency and interfacing organizations)
- citizens band (CB) radio
- programmable scanner (or scannable radio(s))
- portable radio(s)/charger(s)
- telephone(s) - land line
- telephone(s) - cellular
- fax machine - cellular
- photocopier
- AM/FM radio (for monitoring media reports)
- intercom (in compartmentalized vehicle)
- TV monitor/VCR
- video camera/cam-corder.

7.10 Antennae

7.10.1 An antenna grid on the roof should be pre-determined by a qualified radio technician to avoid non-compatible antenna placement. As broad a radio frequency spectrum as possible should be considered.

7.10.2 Antenna leads from the roof should be quick-connected to an easily-accessible terminal block, to which radio antenna cables are also connected. In case of antenna problems, radios can be readily switched to an adjacent compatible antenna at the block to avoid time-consuming rewiring on site.

7.10.3 A spare UHF, and spare VHF, antenna mounted, with cable to communications area (terminal block) will facilitate rapid changeover in the event of failure, as well as providing for connection for another agency's radio brought in during a specific emergency.

7.11 General

7.11.1 Fax machines should be capable of activation on both cellular and conventional (land-line) telephone networks, for maximum flexibility.

7.11.2 A fibreglass body (roof) may create some radio difficulties due to lack of an antenna ground plane.

7.11.3 All wires, cables, coaxial, etc., terminating in the vehicle should be identified to ensure rapid and correct connection during equipment installation, replacement etc.

7.11.4 Battery chargers should be on board which are compatible with all battery powered radios, telephones, etc., carried.

7.11.5 Radios, TV monitors, etc., that are mounted in panels should be capable of removal individually without disturbing other modules, or removing excessive facia.

7.11.6 Radio and PA microphones, when similar in appearance, should be identified to prevent inadvertent misuse.

8. EMERGENCY WARNING SYSTEMS

8.1 Emergency Lights - Positioning

8.1.1 Lights mounted on the hood (Fig.3):

- should not have a shiny housing or mount which reflects the sun or other light into the driver's eyes
- should not be of a rotating beam design unless the lens is masked appropriately to avoid impairing the driver's vision.

8.1.2 Lights mounted on the bumper, grill, or hood:

- should avoid the colours white and amber, due to possible confusion with turn signals,
- should not be installed where they will be confused with, or compete for attention with, the vehicle's turn signals.

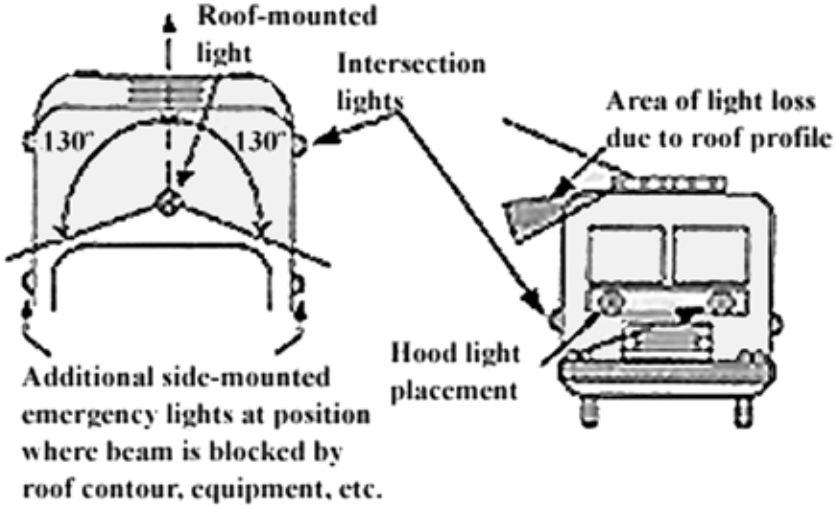

Figure 3: Lights, hood placement/lateral obstruction

8.1.3 Lights, roof and/or side-mounted, intended for right angle/intersection warning should (Fig.3):

- be mounted as far forward as possible
- not be obstructed laterally through 260° (130° on each side of the centre-line of the vehicle) by air horn trumpets, siren speakers, spot lights, Opticom units, etc.
- be supplemented by additional lights, if a centre-line mounted light is not fully visible laterally due to the vehicle's roof contour
- be supplemented with additional "intersection lights" - mounted at eye level, on each side of the vehicle as far forward as practicable.

8.1.4 Lights intended for rear protection should:

- not be obstructed by rear doors in the open position, or as an alternative, have windows through which lights are visible
- be supplemented by additional lights or retro-reflective material, on the inside of doors which extend beyond the vehicle's width
- where roof-mounted, be positioned as far rearward as possible to avoid obstruction by roof contour.

8.2 Emergency Lights - General

8.2.1 The colour(s) of emergency warning lights should be as permitted or mandated by provincial statute.

8.2.2 All lamps shall be mounted so as to produce a light beam parallel to the road surface.

8.2.3 Sealed beam units or halogen bulbs should be used, as opposed to incandescent bulbs, for maximum visibility.

8.2.4 Uni-directional lights flashing in tandem should flash alternately rather than simultaneously, for improved visual recognition.

8.2.5 Automatic flashing headlights ("wig-wags") are contra-indicated, as under certain conditions, such may be misinterpreted as a "go ahead" signal by other drivers, as well as blinding oncoming drivers at night.

8.2.6 Amber emergency lights generally should not be used for "authority" warning, as these are not normally perceived by the public as denoting emergency vehicles. Red (or red in combination with other provincially-sanctioned colours) should be used.

8.2.7 Where the vehicle is to be operated on or beside a roadway, 360° emergency lighting is essential.

8.3 Siren

8.3.1 Siren controls should be mounted:

- below the level of the bottom of the windshield
- as near as possible to the driver to reduce hand and eye travel
- on the left of the driver, to permit use while the right hand (the dominant hand in the majority of the population) remains on the steering wheel for control.

8.3.2 Siren speaker(s) should be mounted at the front of the vehicle, with the projection horn parallel to the road surface, and to the direction of travel.

8.4 Back-Up Alarm

8.4.1 A back-up alarm should be considered. It should:

- activate automatically upon the shifting of the transmission into reverse
- be equipped with an override switch to deactivate the alarm in specific situations
- give a clear signal to the driver when the alarm is in the deactivated position.

8.5 Markings

8.5.1 Retro-reflective material (stripes, patterns, and/or logos) should be considered as a passive warning device, although they may not be appropriate in certain law enforcement covert operations.

8.5.2 Where retro-reflective lettering is used, visibility is improved when the lettering is affixed to a retro-reflective background.

8.6 Turn Signals

8.6.1 Supplemental, side-mounted turn indicators should be considered, to alert overtaking drivers within the length of the vehicle. The signal should be mounted at eye level, in the first third of the vehicle's length, to provide maximum visibility.

9. SUGGESTED EQUIPMENT AND SUPPLIES

The following items are suggested for inclusion on mobile command and similar emergency response vehicles. These are in addition to specific documents, manuals, maps, and supplies related to the specific agency or function of the vehicle:

9.1 With respect to other agencies, and their mobile command posts a:

- list of fax numbers
- list of cellular telephone numbers
- list of tactical radio frequencies (special police frequencies excepted)
- list of any "permanent" land-line telephone numbers
- rail-line mile post cross-reference to street listing (where applicable).

9.2 A weather status board can be helpful to record updated information in hazardous materials operations.

9.3 A "Key Officials on Site" board can be useful in displaying the name of the senior officer of each agency at the scene.

9.4 A wind direction/velocity device and/or a weather band on an existing monitor or scanner can be of assistance in hazardous materials incidents.

9.5 A large-face clock in 24-hour format, visible to all locations (where possible) can avoid time differences as well as continual synchronization.

Digital clocks offer the advantage of not producing the "click" characteristic of sweep face battery clocks, which can be disturbing during prolonged quiet periods.

A second, adjacent clock should be considered where the time in another time zone may be pertinent to operations.

9.6 A first-aid kit, for the use of on-board personnel should be provided.

Any first-aid equipment should be consistent in type with that used by local ambulance services, to facilitate inter-agency use.

9.7 Smoke detectors should be in each enclosed area, as well as cabinets containing electrical connections/equipment, and flammables.

9.8 A long garden-type hose (or Recreational Vehicle water hook-up hose, if used to supply an on-board drinking water source) with standard residential fittings can facilitate filling water tanks on site using residential dwellings, in a protracted incident.

9.9 A funnel can be helpful in filling fuel tanks, especially on generators that may be difficult to access in underbody compartments.

9.10 A small photocopier, if copying is anticipated, may be advantageous. Although most fax machines can also copy, they cannot receive a fax at the same time, and are usually limited in the size of document they can accept.

9.11 A microwave oven on 110 volt (from shore power or generator) may be preferable to a stove to avoid the refilling necessary with propane, Recreational Vehicle-type units.

9.12 Where multiple keys are necessary to operate the vehicle, a key box placed in the vehicle can facilitate storage and retrieval.

9.13 A standard vehicle AM/FM/cassette system can be desirable during long periods of inactivity, especially at night.

9.14 Small signs indicating the method of operation of key pieces of equipment can avoid experimentation, and the risk of damage, by staff.

9.15 Office stationery items, along with applicable forms, appropriate to the vehicle's function, should be carried.

9.16 A circular, lighted magnifier, on an articulated arm (drafting table type) can facilitate review of hard-to-read maps, documents, etc.

9.17 A tool and support kit, including replacement bulbs, etc., as well as appropriate socket wrenches, screw drivers, test light, spare electrical wire, etc., can facilitate minor on-site repairs.

9.18 110-volt extension cord(s), heavy-duty outdoor rated, should be carried, along with a variety of plug adapters, to provide the most options for connection to shore power.

9.19 A device to measure external vehicle skin temperature (as opposed to ambient temperature) may be advantageous in vehicles dealing with hazardous materials incidents.

9.20 Several (four to six) body bags, which should suffice for the majority of non-disaster incidents involving fatalities, can be of use.

9.21 A roll of yellow barrier tape and several traffic pylons can demarcate various areas.

9.22 A boot tray or scraper near the door(s) can avoid tracking mud through the vehicle.

9.23 Adequate, appropriate fire extinguisher(s) should be provided, preferably one in each separate area of the vehicle.

9.24 One or two rechargeable flashlights should be carried.

9.25 Several disposable emergency blankets should be considered.

9.26 Flexible exhaust extension hoses can permit exhaust gases from engine or generator to be channelled appropriately away (i.e. down-wind) from the vehicle.

9.27 A manual for the operation of all on-board equipment should be carried. Such a manual should be confined to operational aspects, and thus the total manufacturer's manual may go beyond what is essential, delaying rapid locating of essential information. Photocopies of relevant pages may be more appropriate. A copy of the manual should be also located at the dispatch office for the vehicle to permit concurrent reference during discussion of a problem on site.

9.28 When developing white board/chalk boards/status and display boards consider:

- Boards that are removable can be taken outside for briefings, providing boards and markers are weather proof.
- Boards should be positioned within the vehicle so as not to be visible through windows.
- Sliding boards on dual tracks, one in front of the other, can increase writing space, as well as covering (yet retaining) sensitive material from unauthorized view.
- Boards that are installed angled outwards at the lower edge can improve ease of writing.
- "Write-on" boards that will hold magnets facilitate repositioning of plotted resources.

9.29 A Personal Amenities Kit should be considered if lengthy incident use is anticipated. Such a kit contains disposable razors and shaving cream, deodorant, antacid tablets, toothbrushes, etc.

APPENDIX

SPECIFICATIONS AND TENDERS

The following general guidelines for use in developing specifications and tenders are suggested.

1. Tenders should require the vehicle converter to be authorized to affix the National Safety Mark, and issue a Statement of Compliance, as prescribed by the *Motor Vehicle Safety Act* (Canada).

2. Tender specifications should be as detailed as possible, and should state sizes, dimensions, quality and standards required, as well as tolerances and the degree of variance, if any, acceptable.

3. Tenders should require any latitude or option exercised by the supplier to be declared in advance, and prior to the tender being awarded.

4. Where dimensions are critical (e.g. the interior measurements of cabinets designed to hold specific equipment), these shall be so identified.

5. Provision for periodic inspection of the vehicle during construction, on the body-builder's premises, should be a requirement of the tender.

6. Warranties should be identified, including the manner in which warranty work is to be performed, as well as for equipment purchased by the supplier from sub-contractors.

7. Receipts to establish clear ownership should be obtained for any items supplied to the contractor for installation in the vehicle, in the event of business failure, termination of the contract, etc.

8. Electrical connections, routing, wiring grades and colours, etc., should be jointly determined in advance of installation. This likewise applies to antenna placement, cable routing, etc.