EMERGENCY MEASURES RADIO GROUP	**EMERGENCY MEASURES RADIO GROUP**
AMATEUR RADIO RAC EMERGENCY SERVICE	**OTTAWA ARES**

Two Names - One Group - One Purpose

EOC Renovation 2007
(City of Ottawa)
EMRG-617

Version: 1.0

EMRG PUBLIC

This document is classified as PUBLIC, meaning the document can be copied and shared by the documents recipient. Public documents do not contain any personal information or other information such as site details that should not be circulated outside of EMRG or its partners.

Public Documents may be posted on the EMRG WEB site without modification.

Written by: Peter Gamble for the EMRG Management Team

TABLE OF CONTENTS

1 REVISION SUMMARY

Date of Change	Revision Number	Summary of Changes (Section #, type of change)
2007-06-20	1.0	Create Original Document

2 PURPOSE OF THIS DOCUMENT

This document explains the renovations made to the City of Ottawa Emergency Operations Centre (EOC) in 2007, the impact of these renovations on EOC Operations, and the impact of these operations changes on EMRG. Finally the document describes the radio communications solution implemented by EMRG to meet these challenges.

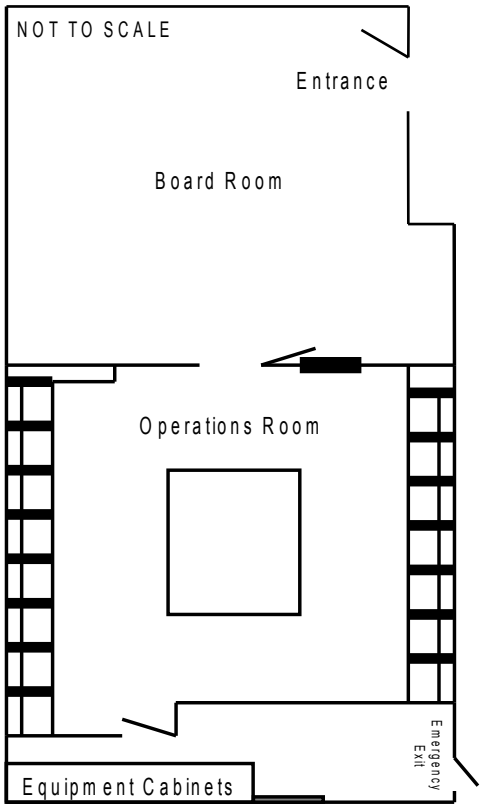
3 EMERGENCY OPERATIONS CENTRE (EOC)

3.1 THE ORIGINAL EOC

The City of Ottawa Emergency Operations Centre (EOC) underwent a major renovation in the spring of 2007 and EMRG communications is part of that renovation. The EOC is located at City Hall and is the decision making centre for the City of Ottawa during a major emergency. The EOC is operated and maintained by the Office of Emergency Management (OEM), formerly known as the Emergency Management Unit (EMU).

During an emergency where the EOC is activated, the head of each department is in the boardroom assessing information and making decisions, while in the operations room, there are representatives from each of these departments, who are the interface to their respective command centre.

In the old EOC, the boardroom and the operations room were attached, leaving insufficient space in either room, plus to exit the operations room, you had to go through the boardroom, which was not convenient. In the operations room, the operator positions were along each wall and consisted of a two foot section of counter with a short wall between each. The users faced the wall they had their back to the people on the other side of the room. Positions were permanently assigned for each organization and some had radios wired to their position, such as Police, Fire, OC Transpo and EMRG.



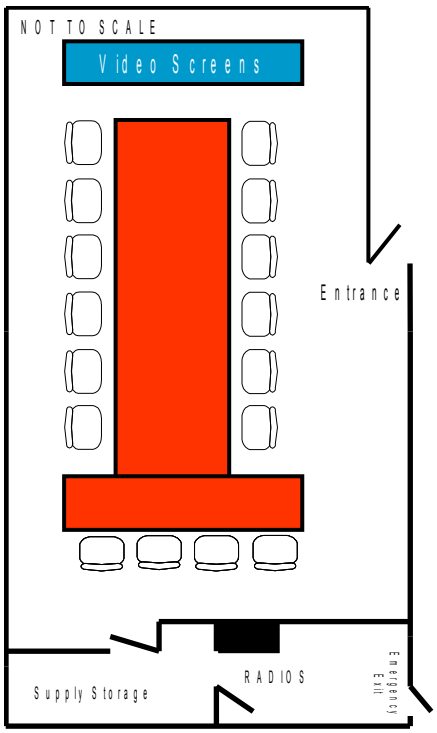
3.2 KEY RENOVATION OBJECTIVES

The renovations in the EOC included many changes and improvements, with the three key operations impacting renovation objectives being;

1. Make all the work positions the same, with no pre-assignment, allowing people to sit where it is most convenient for the specific situation. For example, in a G8 type incident, the Ottawa Police may want OPP and RCMP sitting beside them, while in a Pandemic, the Hospitals, Public Health and Paramedic Services will all want to sit together.
2. Use portable radios, rather than wired radios. In order to assign positions based on the type of event, radios cannot be wired to any specific position. Since there are repeater sites near City Hall for Police, Fire and Paramedics, portables work well from inside the EOC, allowing users to function from any operator position. In the event that the local repeater failed, there are cables in the ceiling, which are wired to external antennas.
3. Have people facing each other, so it is easier to interact within the room. This makes long hours in the room more tolerable and promotes better information sharing.

3.3 THE NEW EOC

The new EOC layout merges the board room and operations room into a single operations room with a fresh look and modern equipment. Each operator position has a phone and computer, plus a large work surface area. The decision makers now use an adjacent boardroom.



4 IMPACTS FOR EMRG

4.1 CHANGES REQUIRED

EMRG was already planning changes to the radio communications wiring in the EOC. Previous exercises and events had shown that communications was difficult with the radio operator in one corner and the partner representatives in another area of the room. The solution being planned was permanent cabling to each partner position with the EMRG Standard Radio Interface (SRI), connected to a patch panel in the equipment room.

The decision to use portables within the EOC turns out to be very positive for EMRG. The primary role for EMRG is to support Community Services, who normally use a telephone or cell phone. In order to be effective, EMRG communications must be co-located with the partner representatives, like the telephone. By using portables and not having pre-assigned positions in the operations room, EMRG can be assigned the position beside the partner representative. Other EMRG partners in the EOC include the Ottawa Red Cross and the Hospitals.

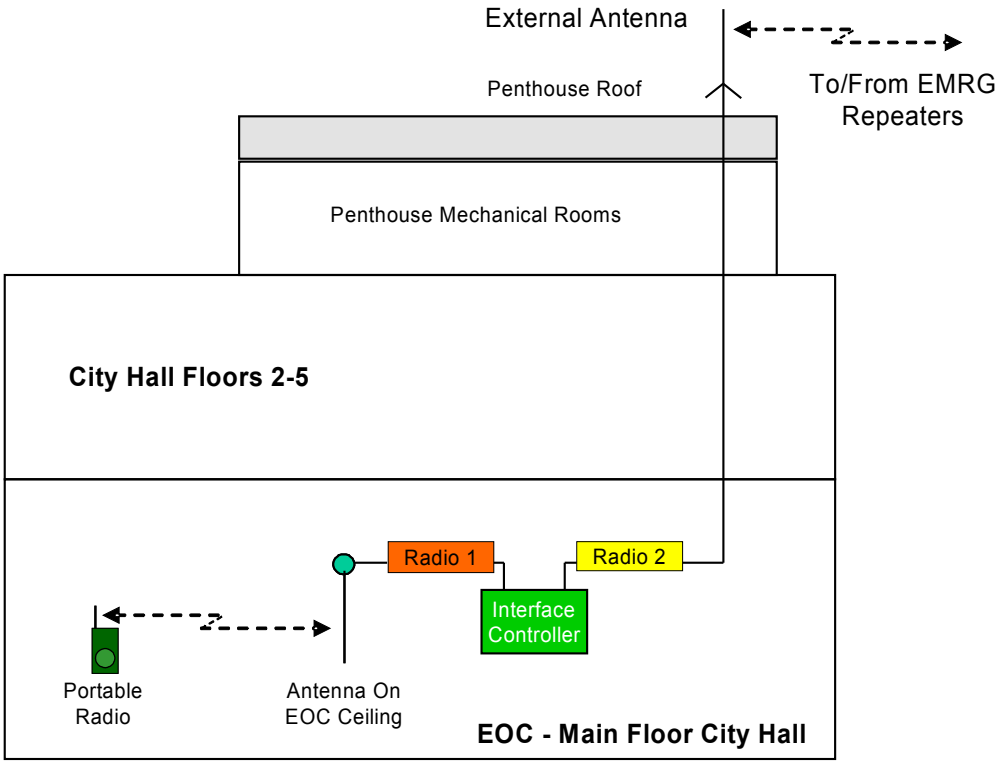
4.2 PREPARING FOR RENOVATIONS

The first step was to remove all the radio equipment from the EOC. EMRG was able to remove all the EMRG radios, plus other now surplus equipment which included a couple commercial VHF radios, about fifteen 25 foot sections of LMR-400 cable with N connectors and 3 full length equipment cabinets with lots of shelving and other hardware. Some of this equipment will be re-used in the new solution and the rest will be used in other EMRG projects.

4.3 DEVELOPING A PLAN

The next step was to come up with a plan for a new EMRG communications solution. Portables are not reliable for EMRG from within the EOC because the EMRG repeaters are located some distance away. The decision was made to implement 3 in-building, in-band repeaters to provide 3 communications channels for EMRG. There will also be a computer for packet with VHF and UHF radio capability, plus a AM/Shortwave multi band receiver and an extra VHF radio. All equipment will have battery backup.

The in-building in-band repeater is like a cross-band vehicle repeater, except the input and output are on the same band, with one radio connected to an antenna inside the building and the other radio connected to an antenna on the roof. The radios can be on the same band because the antennas are separated vertically by about fifty feet of building.



4.4 FUNDING

Some of the equipment for the new solution such as antennas and cables, were already existing at City hall prior to the renovations. Some of the radios were either in the original EOC or EMRG had suitable radios that could be used. Other components such as connectors and cable come from the EMRG project supply, funded by a yearly grant from OEM. However some new equipment was still required to complete the project.

The Office of Emergency Management (OEM) agreed to fund the $3000 required to get additional equipment to support EMRG. The key additional equipment includes a multi-channel UHF high-band commercial radio, dual channel commercial UHF hi-band radio, diplexers and a triplexer for sharing antennas, UPS for the computer and controllers to link the radios together. (For the complete list and cost, see section 6)

4.5 OTHER PROJECTS

The EOC renovations put extra pressure on EMRG in 2007, adding to the already busy schedule of infrastructure improvements underway. While it will take some hard work and planning to get everything done, the EOC changes compliment the other communications infrastructure projects very well, making it well worth the effort.

There are 3 other major projects underway for EMRG in 2007. These include;

1. **Completion of the Red Cross radio system.**
   - The Ottawa Red Cross branch is implementing a new radio communications system. This new system will support 3 voice radio channels on 3 different bands, plus a data channel.
   - The project is funded through equipment donations, Red Cross funding , and a grant from the National Amateur Radio organization, Radio Amateurs of Canada (RAC).
2. **Renovation of the EMRG communications room at OFS Dispatch.**
   - The EMRG communications room is in the basement of the Dispatch centre, and was originally an equipment storage and repair room. The room was made operational for EMRG with the equipment available at the time. The paint is original and the plywood in the counters emits a rather obnoxious odour.
   - With this renovation, 2 mismatched equipment cabinets are being replaced with 2 matching cabinets removed from the EOC, the walls and ceiling are getting fresh paint and the counters are being replaced.
   - The radios are also getting better antennas thanks to new antennas on the OFS dispatch tower. OFS agreed to the changes for EMRG and OEM agreed to pay for the professional riggers required to do the work.
3. **Repeater enhancements, including new repeaters and upgrades.**
   - EMRG has been working on an infrastructure plan since 2005, to implement new repeaters in areas that lack coverage and upgrade existing repeaters.
   - This work takes advantage of OFS radio sites and antennas that are no longer used, since OFS moved to the City Trunked radio system, as well as using equipment that was removed from the old City of Ottawa Carlington Heights radio site.
   - The work requires a lot of coordination and some funding, so progress is slow. The most recent success is improvements to the UHF repeater, which will be finalized with a new antenna on the tower at OFS Dispatch on June 21. OFS agreed to the changes for EMRG and OEM agreed to pay for the professional riggers required to do the work.

5 THE FINAL SOLUTION

5.1 INTRODUCTION

The EMRG final solution for the EOC brings together the capabilities that existed prior to renovations, with the enhancements that were already being planned by EMRG, plus the new requirements based on the EOC renovations. With completion of this project, EMRG will have a robust and flexible communications capability, providing voice and data communications. The solution will reside in an equipment cabinet, so when the EOC moves to a new location in the future, the equipment will move as a functional unit.

5.2 DESIGN DECISIONS

The final design decisions are based on requirements, capabilities and costs. The need for a viable survivable solution must be balanced with the reality of it being used and the ongoing cost in effort and dollars to maintain the system. Key factors used in making decisions for the design are;

1. The EOC is an end point in the EMRG network. Like other agencies in Ottawa, EMRG operates a separate command centre, which is located at Ottawa Fire Service (OFS) Dispatch. From the command centre, EMRG provides on air control of radio channels (Network Control), operations management and planning. The EOC must be able to participate in the radio network, but not control it.
2. Message traffic that requires transmission on HF radio, in order to go beyond the distance of local repeaters, will be done through an HF Relay station, operating from an EMRG members home. City Hall is not a suitable place to operate an HF radio.
3. EMRG is one of many groups operating from the EOC. If power is off, it is off for everyone. While EMRG should be a leader in designing resilient solutions to ensure that communications is not compromised, these solutions should be in line with expectations for other users in the facility. Investing in EMRG 24 hour battery capability is not justified, since the EOC cannot operate for 24 hours without AC power.
4. The solution must have fallback options, so if components fail, there is an alternative means to operate. This may require the radio operator to plug a microphone directly into the radio that has an external antenna for example.
5. There are challenges with providing more than one radio channel on a single radio band, from a single location, due to cross channel interference. Equipment can be installed to make this work, but it is bulky and limits flexibility. The EMRG strategy to address the requirement is to equip all key sites with the capability to operate on 3 different Amateur radio bands, referred to as tri-band. Amateur radio has 3 bands that nicely provide this capability and there are special tri-band antennas that allow the 3 radios to share a common antenna.

6. The antenna used for data should be moved so it is not parallel with the voice radio antenna, since it could cause interference since it is on the same radio band. This can be achieved by installing the data antenna on the South side of the building, near the side of the penthouse where there is steel mesh that can be used as a reflector to limit radio transmission to the North.
   - The penthouse is smaller than the top of the building, so there is a walkway around the penthouse. The roof structure of the top floor and the penthouse are enclosed with large sections of steel mesh to make it visually appealing. The voice radio antenna is on the roof of the penthouse, so the data antenna should be moved to the roof of the building below and be located on the South Side, offset about 40 inches from the steel mesh.
7. Integration of the EMRG data service with the City of Ottawa computer network through computers in the EOC has certain potential benefits, but also has some drawbacks. In order to avoid delays and ensure that the EMRG data network can operate independent of the City of Ottawa network, EMRG will implement a wireless access node in the EOC for EMRG use. The wireless node will allow EMRG to deploy an EMRG laptop computer at any position in the EOC.
   - Once the EMRG data system is working, its' value can be assessed and discussions can take place with partners to determine if integration is a requirement.

5.3 REQUIREMENTS

5.3.1 STANDARD RADIO INTEFACE (SRI)

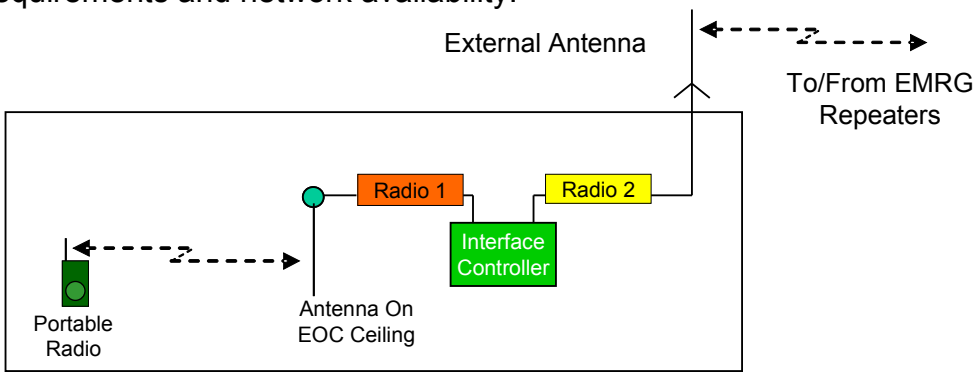
All radios and controllers must be wired with the EMRG Standard Radio Interface (SRI). The SRI is a means of wiring different radios to a common interface, allowing plug and play replacement. The initial implementation may use custom cables to get the equipment installed quickly, with a replacement plan to meet this requirement. (EMRG-210 Standard Radio Interface)

- http://www.emrg.ca/EMRG-210_Standard_Radio_Interface.pdf

5.3.2 THREE VOICE CHANNELS

The EOC final solution will support 3 simultaneous voice channels, one on each of 3 amateur bands; 144MHz (2m), 220MHz (1.35m) and 440MHz (70cm). VHF and UHF portable radios will be used inside the EOC to access in-building repeaters, which in turn access external radio resources on each of the radio bands. The externally connected radios for the in-building repeaters share a single external tri-band antenna.

Each channel has a radio (Radio 1) with internal antenna that remains on a fixed frequency, used to communicate with the portable radios in the EOC. This radio interfaces to a second radio (Radio 2), which is connected to the external antenna. This second radio has multi channel capability, allowing use of any one of many repeater networks or simplex frequencies, depending on the requirements and network availability.



Typically the channels would be assigned to communications functions as follows;

- Channel 1: Assigned for operations because it interfaces to VHF networks that provide City wide radio coverage.
- Channel 2: Assigned for planning because it interfaces with the UHF networks which provide radio coverage in the Urban area, linking all key sites.
- Channel 3: Assigned for Special Services because there are no repeaters, so operations would be Simplex, making it less consistent in terms of coverage area.

The three radio channels would be used to access external networks, which would be used to support different communications functions. The three communications functions that EMRG could support are;

1. **Operations**
   - Used to link multiple sites together providing direct support. The City wide VHF repeaters would be used to link shelters across the City with the EOC, Community Services, Red Cross, etc
2. **Planning**
   - Used to link key sites such as Community Services, Ottawa Red Cross and the EOC, to support planning.
   - The channel could be used for any group that requires communications for a planning or logistics function.
3. **Special Services**
   - Used to provide a radio channel for special applications. This could be to link a few sites together that need to communicate, which are not part of the operations or planning functions.
   - Can be linked to a wide coverage radio in the EMRG Communications Centre at OFS dispatch, allowing communications from the City of Ottawa EOC into neighbouring Municipalities either for Mutual Aid, or for coordination of cross-border emergencies.

In its typical configuration, one radio channel would be assigned for each function. There may be situations where not all functions are required, or where more than 1 network is operating for a specific function. For example there may be 2 planning networks operating independently, so channel 2 would interface to one planning network and channel 3 would interface to the second planning network.

5.3.3 TWO DATA CHANNELS

Amateur radio has a data over radio capability called Packet Radio. This is low speed data, which is very reliable and can cover a wide area. There are software applications available that allow the use of standard email programs plus interfaces to the internet, allowing information to be exchanged as email text and attachments.

The benefit of using the data capability is that it is faster for exchanging lists of information and it can transfer information that is in an electronic format, such as a word document or spreadsheet. While there are limits on the size of documents that can be sent effectively, testing has proven that Amateur radio data communications can be a highly effective communications tool.

EMRG has operated a prototype network for some time, to investigate software and coverage within the City of Ottawa. The VHF channel would be used for operations, while the second channel provides special services.

5.3.4 AM-SHORTWARE RECEIVER

The AM-Shortwave receiver provides a solution for monitoring external AM radio stations as well as some shortwave or Amateur HF communications. This is an existing piece of equipment, so there is no additional cost.

5.3.5 VHF BACKUP RADIO

The VHF backup radio provides an alternate VHF radio for EMRG in the event that the multi channel radio (Radio 2) for channel 1 failed.

This radio and antenna combination is also useful in the event that there is another agency required in the EOC, who either requires an analog VHF radio (148 MHz to 174 MHz), or who requires the use of a VHF antenna (136 MHz to 174 MHz).

5.4 BATTERY BACKUP

The EOC normally runs on AC power, with a backup generator in case the AC power fails. Battery backup is required to ensure equipment operation during the time it takes for the generator to start and come online (appx 30 seconds) and to ensure continued operation if the generator did not start.

The equipment sizing for battery backup of the EMRG EOC solution is based on the following requirements;

1. Channel 1 & 2 are the most important communications components and should be capable of the longest operating time on battery power. The assumed duration is 2 hours, which provides time to, either fix the generator, bring in an alternate generator, or decide to move the EOC to an alternate location.
2. Not all radios are operating at the same time on a continuous basis, so multiple radios can be configured for a single power supply/battery combination. Some radios may be turned off and others may only be used occasionally, making the average power consumption sustainable.
3. The EOC communicates with local repeaters or local sites that have much greater coverage than the EOC. The radios will operate on low power, so multiple radios can be supported from a single power supply/battery combination.
4. Data communications will be capable of lasting 30 to 60 minutes. The cost to ensure longer operating times is not justified.

5.5 IMPLEMENTATION

Configuration, installation and testing of the total solution is a major task for a volunteer organization. This is further complicated by the need to work on other projects in parallel. EMRG will use a phased approach to complete the work.

Phase 1:

- Provide as a minimum, operation of Channel 1 & 2, plus VHF data by Sept 2007. Standard Motorola cables will be used to connect the radios to the RICK controllers.
- This provides the critical communications components.

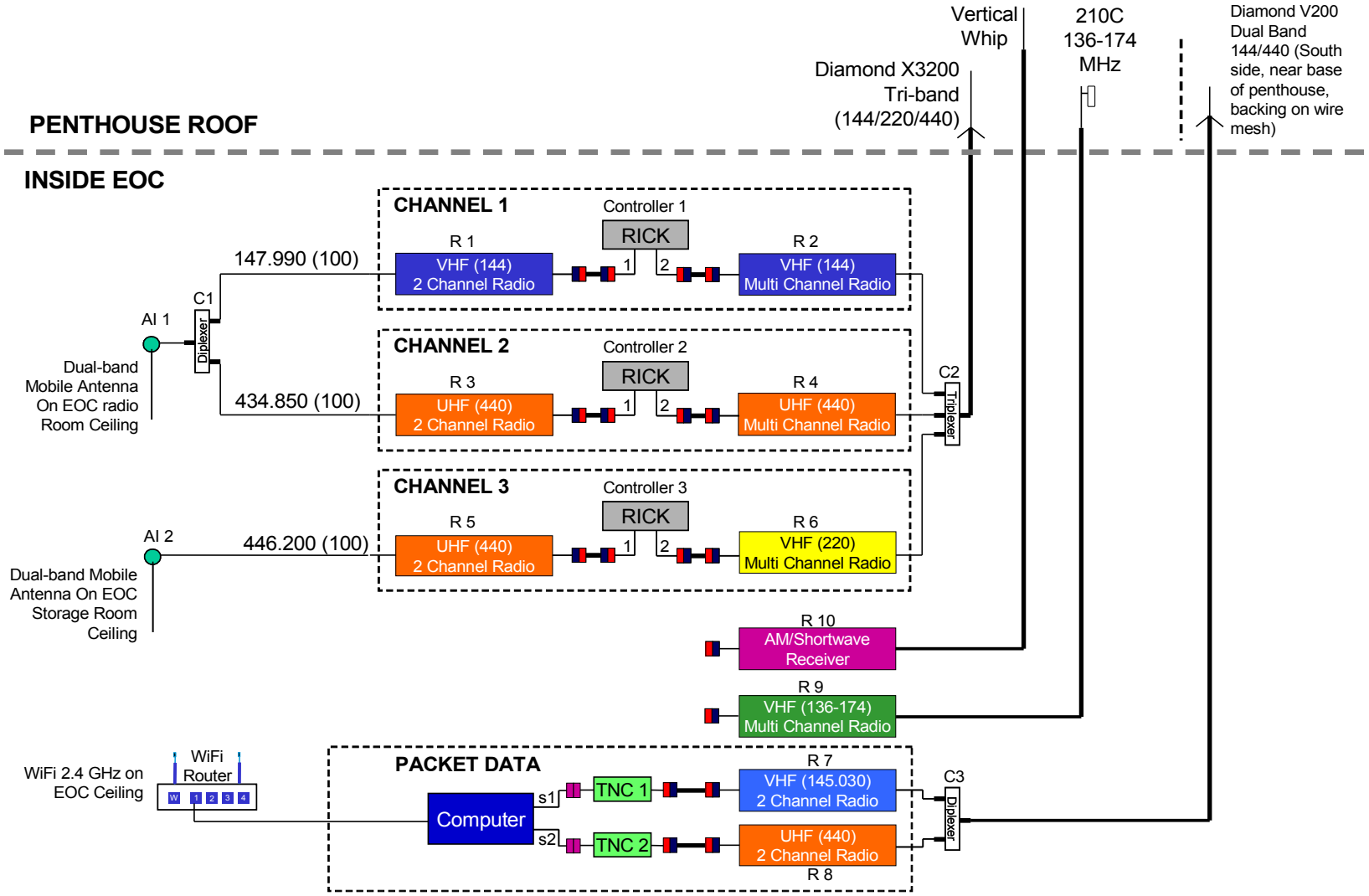
Phase 2:

- Complete the addition of channel 3, the backup VHF radio, the AM-Shortwave receiver and the UHF data channel by the end of 2007.
- This completes the full functionality of the system.

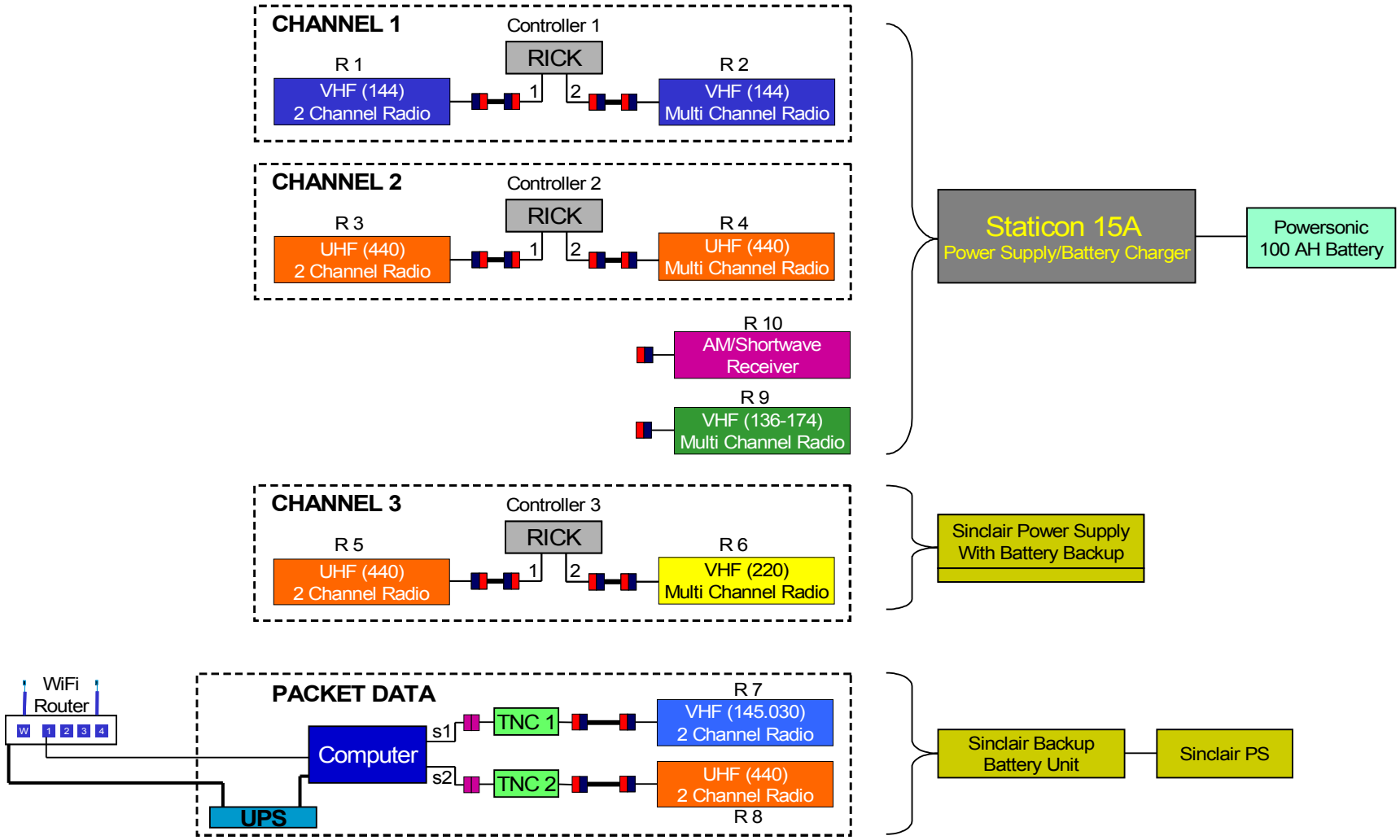
Phase 3:

- Complete the wiring of all radio and controller equipment using the EMRG Standard Radio Interface by the end of 2008.
- It is important to complete this work, but it is lower priority than other projects, such as shelter kits.

5.6 END TO END SOLUTION DRAWING



5.7 BATTERY BACKUP DRAWING



6 SUPPORTING INFORMATION

6.1 MATERIALS LIST

Item	Description	MODEL	Source	Cost
1	Antenna A1 & A2: Dual band VHF/UHF vehicle antenna with magnetic base (Attach to EOC Ceiling)	TRAM 1185	Maple Leaf Communications (New)	$ 78.40
2	Antenna A3, A5, A6	See Drawing	Original EOC Antennas	$ 0.00
3	Antenna A4: Whip for communications receiver	TBD	EMRG Inventory – Donation from EMRG member	$ 0.00
4	Radio R1: Motorola 2 channel VHF radio	Maxtrac	EMRG Inventory (From OFS)	$ 0.00
5	Radio R2: Motorola 32 channel VHF radio	Maxtrac	EMRG Inventory (From OFS)	$ 0.00
6	Radio R3: Motorola 2 channel UHF low-band radio	Maxtrac	EMRG Inventory (From OFS)	$ 0.00
7	Radio R4: Motorola 32 channel UHF hi-band radio	Maxtrac	Bro Comm (Used Commercial Radio)	$ 399.00
8	Radio R5: Motorola 2 channel UHF hi-band radio	Maxtrac	Bro Comm (Used Commercial Radio)	
9	Radio R6: Alinco multi channel 220MHz radio	DR235T	Radio World (New)	$ 364.80
10	Radio R7: GE 2 channel VHF radio	PhoenixSX	EMRG Inventory (Old OEM Radio system)	$ 0.00
11	Radio R8: Motorola 2 channel UHF low-band radio	Maxtrac	EMRG Inventory (From OFS)	$ 0.00
12	Radio R9: Vertex multi channel VHF radio	FTL7011	Original EOC radio	$ 0.00
13	Radio R10: Drake Communications Receiver	R8	Original EOC radio	$ 0.00
14	Controller 1, 2, 3: Motorola RICK (See Note 1)	RICK	NHRC (New) See Note 1	$ 966.33
15	Comet Diplexer C1 + Triplexer C2		Durham Radio (New)	$ 182.67
16	Comet Diplexer C1		Durham Radio (New)	$ 76.90
17	• TNC 1: TNC-X Kit (Group purchase from US Supplier)	TNC-X	TNC-X Developer	$ 113.97
18	• TNC 2: Timewave (AES)	PK232	EMRG Inventory – Donated by local Amateur	$ 0.00
18	Computer	PII 350	EMRG Inventory	$ 0.00
19	Computer LCD Flat Screen		EMRG Inventory – Purchased and donated by EMRG member	$ 0.00
20	Software for Data Resource Sharing	AGWPE Pro	BMT Micro	57.47
21	WiFi Router: Linksys	WRT54G	Best Buy	$ 273.58
22	UPS: APC PC Backup	BX900R-CN	Best Buy	
23	Staticon Power Supply/Battery Charger – 15 Amp		EMRG Inventory (Donation from outside agency)	$ 0.00

24	Powersonic 100 AH battery	01-PS-121000	Total Battery (New)	$ 256.50
25	Sinclair Power Supply with Battery Backup		Original EOC Equipment	$ 0.00
26	Sinclair Battery Backup		Original EOC Equipment	$ 0.00
27	Sinclair Power Supply		Original EOC Equipment	$ 0.00
28	Dual Band Portable Radio (Yaesu VHF/UHF)	FT60R	Radio World (New)	$ 459.14
29	VHF Portable (Kenwood)	TH	EMRG Inventory (Red Cross Donation)	$ 0.00
30	Cube van for moving cabinets from EOC		Paid by EMRG project funding ($88.49)	$ 0.00
TOTAL COST FOR NEW COMPONENTS FOR THIS PROJECT				**$ 3228.76**

NOTES:

1. The RICK controllers were assigned for use in EMRG portable cross-band repeaters. The RICK will work well in this application, so 3 new NHRC-6 controllers were purchased under this project, to replace the RICKs in the portable cross-band repeater project.

6.2 VOLUNTEER HOURS

ITEM	DESCRIPTION	PROVIDED BY	PERSON HOURS
1	Equipment removal from EOC • Includes removal of all cables and delivery of equipment cabinets to OFS Dispatch for storage	EMRG Members	20
2	Planning and documenting the solution • Includes determining which equipment to use, finding best prices, placing orders and receiving goods. • Includes completion of solution document, equipment configuration documents and invoice for new equipment	EMRG Members	70
3	Configuration, installation and testing of equipment in EOC	EMRG Members (Estimated Person hours) • This work is in progress, with phased deliverables and scheduled for final completion by the end of 2007	200