
REVIEW OF POLICE USE OF LONG-RANGE ACOUSTIC DEVICES

MINISTRY OF COMMUNITY SAFETY AND
CORRECTIONAL SERVICES

PUBLIC SAFETY DIVISION

NOVEMBER, 2011

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INTRODUCTION

Long-Range Acoustic Devices (LRADs) are a type of acoustic hailing device (AHD) that provide communication and warning functions using directed acoustic energy.

Multiple models are currently available with common features including two functional settings. The “voice” function acts as a powerful loudspeaker or megaphone while the “alert” function emits a high decibel, narrow frequency, focused set of sound waves.

Prior to the G8 and G20 summits in Huntsville and Toronto in June 2010, the Toronto Police Service (TPS) and Ontario Provincial Police (OPP) procured LRADs for possible use during the summits. The Canadian Civil Liberties Association (CCLA) brought a motion for an interlocutory order restraining these police services from using the alert function on the LRADs and from using the communications function at sound levels above that prescribed under Ontario’s *Occupational Health and Safety Act* (OHSA). No order was made against the OPP while an order against TPS was lifted when that police service adopted the OPP standard operating procedures for its LRADs.

Following the summits, the CCLA wrote to the Ministry of Community Safety and Correctional Services (MCSCS) to state its position that the LRAD is a weapon and its use by police should be regulated as per section 14(1) of the Equipment and Use of Force Regulation (R.R.O. 1990, Reg. 926) under the *Police Services Act* (R.S.O. 1990).

Currently MCSCS does not provide police services in Ontario with direction or guidance regarding their use of the LRAD. However, in response to concerns expressed by the CCLA the Ministry undertook a review of the police use of LRADs, the primary purpose of which was to provide relevant information to assist in determining whether the LRAD should be characterized as a weapon.

The review consisted of the following activities: a jurisdictional scan identifying police services within Canada that are known to use the LRAD; a literature review relating to acoustic hailing devices generally and the LRAD specifically; acoustical testing of particular models of the LRAD to establish noise exposure levels from these devices to enable the assessment of hearing impacts on bystanders and operators and the identification of safe operating parameters; and an examination of the legislative and regulatory framework relating to police use of weapons other than firearms.

This report provides an overview of each of the activities undertaken as part of the review to date and is being provided to the Minister of Community Safety and Correctional Services who will determine future Ministry action on the LRAD once the report is shared with interested stakeholders.

TECHNICAL INFORMATION

LRAD 100X: According to the manufacturer, LRAD Corporation, the LRAD 100X is a self contained, hand portable loud hailer that is 20-30 decibels (dB) louder than most megaphones. The warning tone “provides a non-lethal deterrent, shapes behavior, and supports intent determination while preserving time for force escalation.”ⁱ Other features include: clear communication at up to 1000 meters, 136dB maximum continuous output at 1 meter, and the ability to overcome 88 dB of background noise at 250 metres.ⁱⁱ

LRAD 300X: The 300X is described as “a compact, lightweight communications solution for use on small vessels...and vehicle mounted armour” with extended frequency range, maximum continuous output of 143 dB, and nearly 100% intelligible voice transmission over 88dB of background noise beyond 350 metres and beyond 1500 metres in benign environments.ⁱⁱⁱ

Operators may employ either a hand microphone for direct communication or a digital audio playback device (MP3 player) to broadcast pre-recorded messages, in multiple languages if required.

Both models have volume controls with green, yellow and red settings with corresponding volume levels.

JURISDICTIONAL SCAN

In Canada police services that are known to have acquired LRAD devices are: Vancouver Police Department, Ontario Provincial Police, Toronto Police Service, and Peel Regional Police.

General applications include: marine use; public order; tactical scenarios; disaster/emergency situations; and search and rescue. The primary use of the LRAD is for long-range communication; the alert tone has only been used to get subjects' attention prior to a message being communicated.

Significant media and public attention and concern resulted from the use of the LRAD by the Pittsburgh Police during the G20 Summit in September 2009. Videotaped footage of the event show the police directing the alert function toward activists for minutes at a time in an effort to disperse the crowd.

In response to concerns from the British Columbia Civil Liberties Association, Vancouver Police de-activated the alert function in preparation for the Vancouver 2010 Winter Olympics.^{iv}

In Ontario, common standard operating procedures (SOPs) are in place within two of the three police services that have the LRAD as well as course training standards and material.

Ontario Provincial Police^v

The OPP currently have three LRADs available for deployment in support of the following functions:

- public order operations;
- search and rescue operations;
- tactical operations, including barricaded persons, hostage situations, and high-risk warrant execution; and
- chemical, biological, radiological and nuclear operations.

The OPP SOP states the LRAD shall be deployed with two qualified personnel and is to be used as a communications device. The alert function will only be utilized in two to five second bursts as recommended by the manufacturer.

The LRAD operators must ensure the LRAD 100X is not used at any volume setting if it is within 10 metres of any person. For distances greater than 10 metres but less than 75 metres, the LRAD 100X may only be used in the green and yellow volume settings for either the voice or alert functions. For distances of 75 metres or greater, the 100X may be used at the maximum volume setting for either function.

The LRAD 300X which is capable of a higher output shall not be used at any volume setting for either function when it is within 75 metres of the crowd or the Public Order Unit line.

Toronto Police Service^{vi}

TPS acquired LRAD 100X and 300X models for use by their Public Safety Unit, Marine Unit and Emergency Task Force Unit.

The LRAD is used primarily by the Public Safety Unit to notify the public in large scale evacuations, convey information to large crowds, and for search and rescue operations. Within the Marine Unit, the LRAD could be used for search and rescue operations, maintaining perimeter control for special events, and interdiction.

The main purpose of the LRAD is to provide clear direction to individuals, groups, and victims/bystanders at critical incidents. The LRAD can also be used as a public address system to give direction to training teams in training venues and outdoor firing ranges.

There are specific operating guidelines for activation of the LRAD depending on which unit is deploying it. These guidelines identify that qualified personnel must establish a specified distance in front of the LRAD before activation and when activating the device on full volume. A Laser Range Finder must be used prior to operating the LRAD in order to mark the distance between the crowd and the device.

Similar to the OPP's SOP, the LRAD 100X will only be used at a volume up to the setting between yellow and red when the area in front of the device is between 10 to 75 meters from a person. In order to exceed that volume, circumstances must exist "where it is necessary in order to properly communicate when there is an imminent threat to public safety". In any case full volume will not be utilized within 75 meters. At no time will the LRAD100X be used unless the area in front is clear at least 10 meters.

All operators, unless otherwise designated, must hold the rank of Sergeant or above and must complete training for safe use and operation. Operators must follow direction from their Section Leader when activating the LRAD which must be deployed by two qualified personnel. The alert function will only be utilized one time per incident in two to five second bursts.

Peel Regional Police

Peel Regional Police have LRAD devices available as a communication device for emergency support, including use by the Marine Unit, in tactical situations and in disasters or other public safety emergencies. They have not yet been deployed operationally and Peel's LRAD SOP is still under development.^{vii}

Royal Canadian Mounted Police

The RCMP has not authorised the use of the LRAD system in the field, until further medical research has been completed/compiled and supporting data can provide practitioners with assurance that the LRAD can be used safely and effectively.^{viii}

Training

Common training materials are used by both the OPP and TPS. The OPP's SOP states that all LRAD operators will be trained and qualified by OPP LRAD trainers who have been trained by TPS in conjunction with *Current Corporation* (distributor) utilizing the safety guidelines of *American Technology Corporation*. Training includes both classroom instruction and practical application.

Training topics include the history of the LRAD, specifications, operating procedures, maintenance, applications, safety and practical exercises.^{ix}

LITERATURE REVIEW

Limited research is available on the LRAD or other AHDs. Reports and studies were found primarily within military and law enforcement literature and included LRAD-specific documents, other acoustic device/weapon research and general material on less lethal weapons and related technology.

Some of the research on acoustic hailing devices discusses their use within the broader context of less lethal weapons/technology. These documents define “non-lethal weapons” as “weapons that are explicitly designed and primarily employed so as to incapacitate personnel or material, while minimizing fatalities, permanent injury to personnel and undesired damage to property and the environment”^x. The documents further indicate for less lethal weapons to be useful, they must “incapacitate, debilitate or disrupt the thought process of an individual, several individuals or a crowd of people for a period of time that enables law enforcement or correctional officers to restrain the subject(s) or in the case of a crowd, disperse them or prevent their advance”.^{xi} The three main categories consist of weapons that: fully or partially immobilize movement; deprive or degrade one or more senses; and produce pain^{xii}.

By comparison, the Geneva Academy of International Humanitarian Law and Human Rights defined “weapon” in a 2010 paper as

a device constructed to kill or physically harm, disorient, incapacitate, and/or affect the behaviour of a person against his/her will and/or destroy military, security force, or dual-use materiel [sic], and which acts through the threat or application of force, or other means, such as the transmission of electricity, the diffusion of chemical substances or biological agents or sound, or the direction of electromagnetic energy.^{xiii}

According to the US Joint Non-Lethal Weapons Program an acoustic hailing device is “a non-lethal, counter-personnel, long range hailing and warning device...capable of producing highly directional sound beams, allowing users to project warning tones and intelligible voice commands beyond small arms engagement range. The capability enables U.S. forces to more effectively determine the intent of a person, crowd, vessel, or vehicle, at a safe distance and potentially deter them prior to escalating to lethal force.”^{xiv}

A NATO study from 2006 indicates “acoustic devices are weapons utilizing acoustic energy to induce human effects through the sense of hearing or through the direct impact of pressure waves on other parts of the human body”.^{xv} The proposed desired effects of these devices are to annoy, incapacitate and repel. Non-lethal actions using acoustics range from loud sounds producing a temporary deafness to disagreeable sounds having a psychological effect.^{xvi}

Amnesty International, in its paper entitled “Arms for Repression: Will They be Covered by an Arms Trade Treaty” identifies the LRAD within the category of “directed energy weapons” and states: “whilst promoted as an acoustic hailing device, it can emit a ‘warning tone’, potentially causing long term hearing damage and used as a weapon.”^{xvii}

Acoustic device/weapon applications identified in the research include government uses for border security; crowd control and long-range communication for public safety agencies; and search and rescue and coastal surveillance for harbour/port police.^{xviii} Military applications include enforcement of exclusion zones; critical infrastructure protection; psychological operations; traffic control points/access control points; interdiction operations; checkpoint operations; and detainee operations.^{xix}

While the media may portray acoustic hailing devices and the LRAD specifically as weapons through the use of terms such as “sound cannon” or “sonic cannon”, LRAD Corporation has contested the assertion the LRAD is a weapon. The company states “it is not a weapon, military or otherwise; it is an effective long-range communications device used to clearly broadcast critical information, instructions and warnings...LRAD creates standoff and safety zones, supports the resolution of uncertain situations and potentially prevents the use of deadly force”.^{xx}

Other sources support the notion the LRAD is not a weapon: “regardless of how it has been described by the media, the LRAD is not a weapon if it is used for its intended purpose. Instead, it is a lawful communication tool for use in complex operational environments.”^{xxi}

The manner in which the acoustic device/weapon is used may influence its characterization as either a weapon or a communication device. For example, in a scenario involving the management of a crowd in a disaster or public safety incident, the operational requirement of the device would be to communicate effectively to a non-threatening crowd. In a scenario involving the management of a hostile crowd, the desired outcome is to effectively communicate the intent of law enforcement authorities to the crowd (hail/warn application), interrogate the crowd for “hostile” intent/actors and to separate the “hostile” actors from those who are not intent on causing trouble (weapon application). The desired outcome in a scenario in which the intent of approaching people, vehicles and vessels must be determined, hailing and warning would be utilized to interrogate and determine a peaceful or hostile intent. Finally, if the operational requirement is to deter access to an area, the device can be used as a weapon as well as to hail and/or warn subjects.^{xxii}

A 2007 legal review by the US Department of the Army, Office of The Judge Advocate General found that the LRAD, “when used in the manner proscribed [sic], will not cause permanent damage to the ear or hearing loss.”^{xxiii}

The review did acknowledge that the LRAD had the capability of being "employed with the intent to cause discomfort to the listener"^{xxiv} and that this type of use would convert the LRAD from being only a "communication" device, to becoming a non-lethal weapon.^{xxv} The review also concluded that because the discomfort is well short of permanent damage to the ear, it does not violate the legal threshold of "superfluous injury or unnecessary suffering".^{xxvi}

A 2008 German study suggested categorization of the LRAD as a hailing and warning device and not a weapon "seems appropriate as long as the device is not being used to produce ear pain and as long as levels and durations are limited in such a way that permanent hearing damage is avoided"^{xxvii}. Further, it is suggested that if used by security personnel for purposes other than hailing and warning, an evaluation of the LRAD in the context of police law and human rights is needed: "one can make the case that producing permanent hearing damage while attempting to repel criminals who do not shy away from firing at people, is fully justified. However, this consideration should be made explicitly and systematically before such use, with tests and evaluation, as with other types of police weapons and equipment."^{xxviii}

A study from the University of Bradford (UK) indicates the LRAD is referred to by the military as an "acoustic hailing device" rather than a weapon and "it can be used in this manner but at high power levels and close ranges it can cause ear discomfort and permanent hearing damage."^{xxix}

Many of the sources located assessed the use and effectiveness of the LRAD or other acoustic hailing devices as weapons. For example, testing performed by the Canadian Forces Maritime Warfare Centre concluded the LRAD "does not produce sound pressure levels or other effects sufficient to cause incapacitation or significant physical irritation at operationally significant ranges in a maritime environment. It is therefore concluded that LRAD should be deemed to be ineffective as a NLW (non lethal weapon)".^{xxx}

The University of Bradford study suggests: "despite research attempting to harness acoustic energy for use as weapons, few devices have emerged. It has proved difficult to produce acoustic energy in a directional beam and there are no proven effects of non-audible frequencies, infrasound and ultrasound, or viable effects of audible frequencies at levels that do not risk hearing damage."^{xxxi}

Similarly, an earlier study from 2001 states "the promise by acoustic-weapons proponents of 'no lingering damage' could only be implemented by fairly drastic limits, say a sound level of no more than 120 dB at anybody's ear. This, however, would forego many of the hoped-for effects of acoustic weapons."^{xxxii} This position is supported by the German study that states "acoustic weapons would clearly not be the wonder weapons as sometimes advertised. Their use in armed conflict or for law enforcement would raise important issues concerning unnecessary suffering, protection of outsiders, and proportionality."^{xxxiii}

A more recent study from 2010 made a similar finding: “acoustic weapons will probably not fulfill their early promise. In particular, they will not incapacitate opponents. Many types of acoustic weapons would be large and difficult to handle, thus the interest of military and police may remain limited to hailing and warning devices.”^{xxxiv}

A NATO report made a general comment about the effectiveness of acoustic weapons, stating: “a large variety of acoustic devices have been proposed for non-lethal applications. Most are of uncertain effectiveness and many could damage hearing.”^{xxxv}

However, another NATO report speaks to both the effectiveness of the LRAD as a weapon and its potential for injury: “frequency and power of the weapon can rapidly overcome even highly-motivated individuals. If badly used, they can cause irreversible damage to the hearing apparatus.”^{xxxvi}

The potential for hearing damage arising from use of the LRAD or other acoustic devices was discussed in a number of studies:

Noise induced permanent hearing loss is the main concern related to long-term exposure from the LRAD while acoustic trauma, temporary hearing loss and possibly permanent hearing loss are also concerns related to short term unprotected exposure from the LRAD at high volume levels and short-range (particularly the high frequency warning tone).^{xxxvii}

When the effects of an NLW acoustic system depend on the loudness of the sound, there is usually a risk of permanent hearing damage.^{xxxviii}

In the warning mode the LRAD produces sound pressure levels which are dangerous to hearing if unprotected target subjects are exposed longer than certain durations: a few seconds to 50 m distance, 1.5 minutes at 100 m. Below about 5 m, any exposure can produce permanent hearing damage.^{xxxix}

The LRAD is capable, if used improperly of permanently damaging human hearing.... incorrect LRAD use could permanently damage hearing when forces are attempting to disperse large group of civilians, resulting in harmful tactical and strategic effects.^{xl}

The LRAD produces sound levels that may increase the risk of long-term hearing loss if not properly managed. Increased risk is unlikely to be experienced by the targets of LRAD communications or warning, but is more of a hazard for operators and bystanders in the immediate vicinity of the device.^{xli}

While hearing damage has been identified as a potential outcome of the use of the LRAD in certain circumstances, one researcher recommends the following regarding its operational deployment: “to avoid permanent damage to hearing, the Long Range Acoustic Device should be provided with a component which in the warning mode limits the exposure time depending on distance.”^{xlii} In addition, one specific approach might be to “demand a limit of 120 dB at any publicly accessible point in the case of fixed strong sources. Mobile acoustic weapons could be banned – or limited to very low numbers for specific police uses – if they could produce more than, say, 130 dB at 5 m distance.”^{xliii}

Many of the reports and studies identified offered general recommendations pertaining to the cautious use of the LRAD such as the following from the Canadian Forces Maritime Warfare Centre: “Doctrine for LRAD use as an acoustic communication and warning device must include guidance on duration of transmissions, minimum range and management of power settings in order to minimize risk to the targets of warning or other communications.”^{xliv}

Although this review is limited to examining issues pertaining to the safety of the LRAD, some research has taken place that seeks to establish its effectiveness, not only as a potential weapon as discussed above, but as a communication device.

The Home Office Scientific Development Branch (UK) conducted an evaluation of the intelligibility of the LRAD communication function and found the LRAD “is capable of meeting some of the operational requirements for long range intelligible communication.”^{xlv} Results from the subjective human assessment showed the LRAD produced effective and intelligible communication (>80% correct understanding of single words) up to ranges of 150m only using pre-recorded human speech samples played through the LRAD’s MP3 player and when background noise levels at the receiving position were low (below 65 dB). However, speech intelligibility was substantially reduced for live speech through the microphone.^{xlvi}

One of the operational requirements against which the LRAD was assessed, was accuracy. The report stated that “although the LRAD does demonstrate some degree of directionality for the audio output it is not capable of meeting the accuracy requirement for discriminate communication within a crowd.”^{xlvii}

Another study found that in relation to acoustic technology, “new technology has reduced the power requirements and dramatically increased both effective range and directionality of the sound waves in some types of acoustic energy devices. The new devices greatly enhance audible communication at long ranges”.^{xlviii}

Finally, the Canadian Forces Maritime Warfare Centre study also assessed the effectiveness of the LRAD as a communication/warning device and found the LRAD “demonstrated a capability to extend verbal communications and project

warning tones to operationally useful distances...The warning tone and voice transmissions were readily heard and understood at approximately 2,000 yards...^{xlix}

ACOUSTIC TESTING AND ASSESSMENT

Hatch Associates Report

Previous acoustic testing of the LRAD was conducted by Hatch Associates in June 2010 for the purpose of the G20 injunction hearing. The report examined the SOPs of the OPP for the LRAD 100X and 300X units and the potential noise exposure for the operators and members of the public.

The testing results established exposures of 84.4 dBA (A-weighted decibels) for the crowd and 86.2 dBA for the operators meaning that the estimated noise exposure of the most exposed people in the crowd would be below the daily exposure mandated for workers in Ontario.ⁱ For these individuals, “wearing hearing protection or even putting their fingers in their ears would also significantly reduce their noise exposure.”ⁱⁱ

For the LRAD operators, however, their estimated exposure would be over this limit although hearing protection would lower their exposure to the requisite levelⁱⁱⁱ.

The report concluded that at stand-off distances identified in the OPP SOP, exposure for the crowd/public would be below the daily exposure mandated for workers in Ontario, and officers/operators would be required to wear hearing protection.

While the testing conducted by Hatch Associates was limited to an open air environment (i.e., large open space with no buildings or structures), the report’s author acknowledged during cross examination at the injunction hearing that within a city setting the sound levels of the LRAD could be 3 to 6 dB higher than in an open air environment.

HGC Engineering Report

To augment the testing done by Hatch Associates, MCSCS retained HGC Engineering to conduct acoustic testing and an assessment of the sound produced by the LRAD. The purpose of the testing and subsequent analysis was to establish the noise exposure levels from the LRAD 100X and 300X and submit a report regarding the potential hearing impacts on operators and bystanders and the development of safe operating parameters.

Testing was conducted in a free field (large open space) environment on a range at Canadian Forces Base Borden on June 20, 2011 and included sound pressure level (SPL) measurements at various angles, distances and equipment settings to determine the sound power, acoustic directivity and sound propagation of the LRAD 100X and 300X devices. The measurement results were used as input to a computer model of the noise produced by the devices, which was then used to simulate specific crowd management operational policing scenarios similar to the urban canyon environment of the G20 event in Toronto in June 2010.

The direct measurements and results of the simulations were used to: evaluate the relationship of the sound exposures of operators and bystanders to the noise exposure standards established under the OHSA; evaluate the potential hearing impacts on those persons included in the operational scenarios; and provide recommendations to assist the ministry in developing operating parameters and risk mitigation practices for police use.ⁱⁱⁱ

Measurement Summary and Data Analysis

Sound pressure level measurements were taken of the LRAD 100X and 300X models at distances of 3, 10, 20, 40, 80, 160, 320 and 450 metres and at a series of radial locations: at 10 degree intervals between 0 and 90 degrees and at 30 degree intervals between 90 and 180 degrees all at a distance of 40 metres from the front of the device.

At each of these locations an SPL measurement was taken during the playback of a recorded announcement and during the emission of the alert mode tone.

As shown in Table1 below, the measurements of the 100X taken at full volume ranged from a high of 113 dBA at 3 metres for the voice function and 126 dBA for the alert function attenuating to 53 dBA (voice) and 59 dBA (alert) at 450 metres.

Table 1: On-Axis Sound Pressure Level Measurements, LRAD 100X

| Distance | Mode | Sound Pressure Level (dBA) |
|------------|-------|----------------------------|
| 10 metres | Voice | 103 |
| | Alert | 116 |
| 20 metres | Voice | 98 |
| | Alert | 109 |
| 40 metres | Voice | 92 |
| | Alert | 103 |
| 80 metres | Voice | 76 |
| | Alert | 86 |
| 160 metres | Voice | 62 |
| | Alert | 75 |
| 320 metres | Voice | 54 |
| | Alert | 70 |
| 450 metres | Voice | 53 |
| | Alert | 59 |

The LRAD 300X has additional features including a wide/narrow sound projection toggle and selectable voice boost mode. Measurements for the 300X at full volume in the narrow projection mode with the voice boost off are presented in Table 2 below:

Table 2: On-Axis Sound Pressure Level Measurements, LRAD 300X (narrow projection mode, voice boost off)

| Distance | Mode | Sound Pressure Level (dBA) |
|------------|-------|----------------------------|
| 10 metres | Voice | 113 |
| | Alert | 123 |
| 20 metres | Voice | 108 |
| | Alert | 116 |
| 40 metres | Voice | 99 |
| | Alert | 105 |
| 80 metres | Voice | 83 |
| | Alert | 88 |
| 160 metres | Voice | 64 |
| | Alert | 74 |
| 320 metres | Voice | 58 |
| | Alert | 69 |
| 450 metres | Voice | 57 |
| | Alert | 65 |

Measurements were also conducted at two locations to investigate the sound levels to which operators are exposed in the field and to determine the level of exposure with respect to limits identified in the OHSA. One location was at the ear of the head and torso simulator that held the 100X and the other was

approximately 5 metres behind the 300X which represents a typical operator location during the deployment of that model.

Operator exposure to the sound emissions during the testing was calculated using methods contained in Ontario Health and Safety Guideline: “Amendments to Noise Requirements in the Regulations for Industrial Establishments & Oil and Gas-Offshore”.^{liv} The equivalent sound exposure level in eight hours ($L_{ex,8}$) for the 100X was 87 dBA and 83 dBA for the 300X.

The report identified worst case conditions in which the operator is exposed to sound being continuously emitted from the devices for different exposure periods. At the maximum exposure time of 8 hours, the $L_{ex,8}$ for the 100X is 106 dBA and 97 dBA for the 300X. At the minimum exposure time of 1 minute, the $L_{ex,8}$ for the 100X is 79 dBA and 70 dBA for the 300X.^{lv} The OHSA establishes an 85 dBA $L_{ex,8}$ exposure limit for workers.

To provide some perspective, the sound level of normal speech is approximately 65 dBA at a distance of 1 metre^{lvi}; a fire truck siren is approximately 120 dBA^{lvii}; a leaf blower is between 95 and 105 dBA^{lviii}; and some subways exceed 90 dBA^{lix}.

While identifying the worst case situation as a bystander situated directly in front of the LRAD operated at full volume on alert mode, the report does not identify sound exposure levels ($L_{ex,8}$) for bystanders. The reasons cited include the lack of information regarding the duration or duty cycle of the exposure during an actual deployment as well as the significant levels of extraneous noise (e.g., horns, shouting) that bystanders could be exposed to which would increase their exposure.^{lx}

Acoustic modeling was also utilized to predict sound pressure levels at two locations in Toronto: the south end of Queen’s Park Circle and 400 University Avenue adjacent to the US Consulate. These locations which were chosen to represent operational policing scenarios similar to the G20 event in Toronto. Both of these sites are common locations for large demonstrations.

The following table shows the measurements taken in the open air setting and the values for the Queen’s Park and US Consulate models, all on-axis at 20 metres.

Table 3: Open Air and Operational Scenario Model Sound Levels

| | 100X (voice) | 100X (alert) | 300X (voice) | 300X (alert) |
|--------------|--------------|--------------|--------------|--------------|
| Open air | 98 dBA | 109 dBA | 108 dBA | 116 dBA |
| Queen’s Park | 98 dBA | 109 dBA | 107 dBA | 119 dBA |
| US Consulate | 95 dBA | 105 dBA | 104 dBA | 117 dBA |

Differences between an open air setting and urban scenario can arise as a result of reflections from buildings. However, these effects are not great, generally being on the order of several decibels, and only for bystanders located quite close to buildings. The lower LRAD 300X values associated with the US Consulate location above reflect the fact the modeling was based on the LRAD 300X device being deployed at an elevated height.^{lxi}

Recommendations

Based on the analysis of the measurements and modeling, consideration of exposure standards established in the OSHA and consultation with an audiological professional, the report recommends the following minimum distances at which the devices should be used at various volume settings. These limits represent distances at which a sound level of 100 dBA would not be expected to be exceeded under the worst case conditions (full volume control setting, reflective ground surface, receptor located on the axis of the device at a location near a building) in the urban scenarios. Fifteen minutes of unprotected continuous exposure to 100 dBA corresponds to an equivalent sound exposure level over 8 hours ($L_{ex,8}$) of 85 dBA.^{lxii}

Table 4: Distances (metres) to 100 dBA, Urban Scenarios

| Device | Operating Condition | Maximum Volume Setting | Border of Red/Yellow Range | Border of Yellow/Green Range |
|-----------|---------------------|------------------------|----------------------------|------------------------------|
| LRAD 100X | Voice | 20 | - | - |
| LRAD 100X | Alert | 60 | 25 | - |
| LRAD 300X | Voice | 60 | 25 | - |
| LRAD 300X | Alert | 200 | 125 | 75 |

The report also recommends the following safe operating parameters for use of the LRAD:

- 1) The LRAD devices are provided with a warning notification for operating personnel on the rear panel concerning the fact that they produce high levels of sound. Operators should be made aware if these notifications and trained in the use of the devices.
- 2) Operators of the LRAD 100X device should wear hearing protection devices (HPDs) during equipment operation (chest worn). The HPDs should provide a minimum Noise Reduction Rating of NRR 28 as

determined from the worst case Lex,8 of 106 dBA using the methods contained in [4 of the HGC Report]. These could be either of the foam plugs or over the ear variety.

- 3) Operators of the LRAD 300X devices should be located at least 2 metres to the rear of the device, ideally at an angle of 135 or 225 degrees from the forward axis of the device. At this distance, HPDs (minimum NRR of 28) should be worn during equipment operation.
- 4) Operators of the LRAD 300X devices are not required to wear HPD's for short term operations (up to 15 minutes of daily exposure) if they are located at least 5 metres from the device, but should consider wearing HPD's at all times to prevent inadvertent over exposure.
- 5) Recorded voice announcements should be recorded using good engineering practice (i.e., appropriate record level with no overloads). Existing and future recordings should be reviewed to ensure that recordings other than the recording used in the testing described here do not result in higher than anticipated sound pressure levels.^{lxiii}

In addition, recognizing that use of the LRAD in certain circumstances may result in hearing risks for operators and bystanders, the report recommends the following risk mitigation practices:

- 1) Operating personnel should participate in training to gain experience as to the required volume level in various situations.
- 2) The use of the alert function should be minimized.
- 3) The LRAD devices should not be operated continuously. Any recorded communication or alert should be followed by an equivalent period of silence to still allow for effective communications while reducing bystander exposure.
- 4) Devices should be operated at volume setting and distances from bystanders which are consistent with the on-axis minimum distances provided in Table 4.
- 5) Notwithstanding the absence of a minimum distance requirement for certain conditions in Table 4, it would be good practice not to operate the devices where bystanders are located within 10 metres of the device for those conditions.
- 6) Volume setting notwithstanding, the voice lift function of the LRAD 300X should not be used if bystanders are located closer than the minimum distances provided for the maximum volume setting in Table 4.

- 7) The minimum distance provided for the maximum volume setting in Table 4 does not apply to the LRAD 100X in communication mode, if the device is mounted at a height of at least 4 metres above grade, oriented in a horizontal direction (i.e., not angled down).^{lxiv}

LEGISLATIVE AND REGULATORY FRAMEWORK

The *Police Services Act* authorizes the Lieutenant Governor in Council to make regulations regulating and prohibiting the use of any equipment by a police force or any of its members (s. 135(1)15) and regulating the use of force by members of police forces (s. 135(1)16).

Regulation 926, Equipment and Use of Force, has been made under the *Police Services Act*. Subsection 14(1) of the Regulation prohibits a member of a police force from using a weapon other than a firearm on another person unless (a) that type of weapon has been approved by the Minister, (b) the weapon conforms to technical standards established by the Minister, and (c) the weapon is used in accordance with standards established by the Minister. The Regulation does not define “weapon” or specify what constitutes use of a weapon on another person.

STAKEHOLDER CONSULTATION

The following organizations were provided with the Terms of Reference for the review and were invited to offer feedback. The ministry has endeavoured to keep the stakeholders apprised of the progress of the review and they will be provided with this report.

Canadian Civil Liberties Association
Canadian Hearing Society
Canadian Association of Speech Pathologists and Audiologists
Ontario Association of Speech Pathologists and Audiologists
Ontario Federation of Labour
Ontario Association of Chiefs of Police
Ontario Association of Police Services Boards
Police Association of Ontario
Ontario Senior Officers Police Association
Ontario Provincial Police
Toronto Police Service
Peel Regional Police

SUMMARY AND NEXT STEPS

In an effort to address public concerns regarding use of the LRAD by police, MCSCS has undertaken this review to examine existing research and literature on the LRAD, how the LRAD is currently being used by Canadian police services, and issues relating to its safe operation.

The literature review identified sources that described acoustic hailing devices as both non-lethal “devices” and non lethal “weapons”. Some indicated AHDs are not weapons while others suggested they would be ineffective as weapons.

Acknowledging the potential for injury that may occur as a result of their use, some of the sources identified in the literature review expressed the position that AHDs may be considered weapons depending on the manner in which they are used. This type of position lends itself to recommendations or restrictions governing their use that take into account factors such as volume levels, stand-off distances and the use of hearing protection devices that aim to minimize or eliminate any risks to hearing.

The acoustic testing and evaluation of hearing impacts has assisted in identifying appropriate operating parameters and risk mitigation strategies to inform the development of policies and standard operating procedures within police services.

The Minister of Community Safety and Correctional Services will be examining all outputs of the review and will determine the nature of any future action to be taken in relation to police use of the LRAD.

ⁱ LRAD Corporation website: <http://www.lradx.com>.

ⁱⁱ Ibid.

ⁱⁱⁱ Ibid.

^{iv} “VPD Will Disable ‘Sonic Cannon’ Chu Tells Police Board, Mayor Robertson Gives Chief His Vote of Confidence”, The Vancouver Observer, November 18, 2009.

^v Ontario Provincial Police, Long Range Acoustic Device Standard Operating Procedures.

^{vi} Toronto Police Service, Public Safety/Marine/Emergency Task Force Unit Specific Guidelines for the LRAD

^{vii} Inspector Perry Kirchof, personal communication, September 14, 2010.

^{viii} Royal Canadian Mounted Police. “RCMP Evaluation of the LRAD”. (Internal memo).

^{ix} Toronto Police Service, LRAD Operators Course presentation

^x US Department of Defence. Directive 3000.3, Policy for Non-Lethal Weapons, July 1996, p.2.

^{xi} Downs, Raymond L. “Less Lethal Weapons: A Technologist’s Perspective”, 2007, p. 359.

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- ^{xii} Ibid., p. 359.
- ^{xiii} Casey-Maslen, Stuart. "Non-kinetic-energy weapons termed 'non-lethal': A Preliminary Assessment under International Humanitarian Law and International Human Rights Law", October, 2010, p.4.
- ^{xiv} Department of Defence, Joint Non-lethal Weapons Program. "Acoustic Hailing Devices (AHD) Fact Sheet", February, 2008, p.1.
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- ^{xvi} Ibid., p. 4-2.
- ^{xvii} Amnesty International. "Arms for Repression: Will They be Covered by and Arms Trade Treaty?" 2011, pp 21-22.
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- ^{xix} Ibid., p. 46.
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- ^{xxx} Canadian Forces Maritime Warfare Centre. "Long Range Acoustic Device Non-Lethal Weapon Test", September 18, 2010., p.8.
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- ^{xxxiii} Ibid., p. 207.
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- ^{xxxv} North Atlantic Treaty Organization. The Human Effects of Non-Lethal Technologies, August, 2006, p. G-4.
- ^{xxxvi} North Atlantic Treaty Organization. Non-Lethal Weapons and Future Peace Enforcement Operations, November 2004, p. 3-11.
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- ⁱⁱⁱ Ibid., p.8.
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