Appendix 2 – Hearing Damage Risk Criteria

Damage risk criteria (DRC) are used to specify a maximum allowable noise level (MANL) and the maximum allowable exposure time (MAET) to prevent the occurrence or reduce the progression of an existing noise-induced hearing loss (NIHL). The MANL depends on the maximum acceptable occupational hearing loss (MAOHL) and excess risk defined as the difference between the percent of people that exceed the MAOHL in an occupational noise-exposed minus an unexposed population. The MAET is typically an 8-hour day and is reduced if the noise level exceeds the MANL using a time/intensity relation called the exchange rate (ER).

The DRC used by the Occupational Health and Safety Administration (OSHA) uses a MAOHL >25 dB for both ears averaged over 1000, 2000, and 3000 Hz and a MANL of 90 dBA for an 8-hour day and a 5 dB ER. That is, if a noise is >90 dBA then the MAET is reduced by one-half for every 5-dB above the MANL (e.g., 8-hrs at 90 dBA, 4-hrs at 95 dBA, 2-hrs at 100 dBA, etc.). The MANL is 115 dBA regardless of the MAET. The 5-dB ER is based on the premise that noises that produce equal amounts of temporary threshold shift also produce equal amounts of permanent threshold shift or NIHL.

The most recent DRC used by the National Institute for Occupational Safety and Health (NIOSH) uses a MAOHL >25 dB for both ears averaged over 1000, 2000, 3000, and 4000 Hz. The DRC used by the ACGIH and in MIL-STD 1474D use a MAOHL (called the threshold limit value) >25 dB for both ears averaged over 500, 1000, 2000, and 3000 Hz. The NIOSH, ACGIH, and MIL-STD are more conservative than the OSHA DRC because they all use a MANL of 85 dBA for an 8-hour day and a 3 dB ER. That is, if a noise level is >85 dBA then the MAET is reduced by one-half for every 3-dB above the MANL (e.g., 8-hrs at 85 dBA, 4-hrs at 88 dBA, 2-hrs at 91 dBA, etc.). The 3-dB ER is based on the premise that sounds having equal amounts of energy will be equally hazardous and is more strongly supported by research compared with the 5-dB ER. The ACGIH DRC was designed to protect the median population against a MAOHL >2 dB after 40 years of occupational noise exposure. Further, the ACGHI specifies a MANL of 80 dBA for a 24-hour day with a 3 dB ER so that at 139 dBA the MAET is .11 seconds.

Even though several studies have been conducted and national and international standards have been developed, it is very difficult to define excess risk due to several variables including the statistical modeling method, type of noise, MAOHL, age, gender, race, exposure level, and years of exposure. Table 1 shows mean and 95% confidence interval (CI) 1997 NIOSH excess risk estimates for the MANLs of 85 and 90 dBA for 5 to 10 and >10 years of exposure for workers 30 and 60 yrs old (Prince, M.E., et.al., (1997). A re-examination of risk estimates from the NIOSH occupational noise and hearing survey (ONHS). Journal of the Acoustical Society of America, 110(2), 950-963.). Because the Table 1 excess risk estimates are based on the NIOSH MAOHL that includes 4000 Hz, excess risk estimates for the OSHA, ACGIH, and MIL-STD 1474 MAOHL that does not include 4000 Hz would be slightly lower.
For military personnel the ACGIH/MIL-STD 1474D DRC (85 dBA MANL, 3 dB ER) should be used for determining LRAD safe operating noise levels. Considering the majority of military personnel potentially using the LRAD will be ≤30 years old and have <10 years of occupational noise exposure they will be at very minimal risk (about .3 to 3.2%) for NIHL. If the LRAD noise level exceeds the ACGIH/MIL-STD 1474D DRC, military personnel can use a hearing protection device to remain at very minimal risk for NIHL.

The OSHA DRC (90 dBA MANL, 5 dB ER) should be used for determining LRAD safe operating noise levels for non-military personnel. Even though the excess risk levels for the OSHA DRC are higher than the ACGIH/MIL-STD 1474D DRC, non-military personnel will still be at minimal risk for a NIHL especially if they are younger and have less years of occupational noise exposure (2.1 to 9.5%). In addition, the OSHA DRC is the mandated DRC used by the U.S. industries. As such, the U.S. Department of Labor (OSHA) has accepted the excess risk estimates to prevent the occurrence or reduce the progression of a NIHL due to occupational noise exposure.

Note: Acoustic safety standards are stated relative to average human hearing thresholds, dBA. This unit is about 5 dB higher than the 20 Pa reference in the dominant voice frequencies. The two units closely agree at the peak LRAD SPL output frequencies of 2 – 3 kHz.
Appendix 3 - Recommended Guidance for Operators in the Field (Preliminary)

**WARNING:** Only properly trained operators/crews should operate the LRAD. Improper use could result in hearing loss to operators and/or targeted subjects.

✓ The tone mode should only be used for 2 to 5 seconds as a “hail” in order to gain the attention of subjects. This should be followed by a recorded or other voice “warning.”

✓ The tone mode should only be used for targeted subjects beyond a range of 75 meters at the MAXIMUM power and MAXIMUM volume settings.

✓ The tone mode should only be used for targeted subjects beyond a range of 15 meters at the LIMITED power and MAXIMUM volume settings.

✓ In the TONE mode, operators should ensure no targeted subjects, bystanders, or friendly forces are occupying the applicable TONE or VOICE-TONE HAZARD AREAS before engagement.

✓ In the VOICE mode, operators should ensure no targeted subjects, bystanders, or friendly forces are occupying the applicable VOICE-TONE HAZARD AREA before engagement.

✓ Operators/crew should wear hearing protection when operating this device.