Understanding Public Acceptance of Rotorcraft

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Key Issues for Land Use Planning Related to Rotorcraft Operations in Noise Sensitive Areas

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ERF September 2003 – Public Acceptance
Presentation, in part, is based on Survey/Study conducted for Westland Helicopters (now part of AgustaWestland) and papers published during period 1994-1999 jointly by Dr John W. Leverton, President, Leverton Associates and A.C (Tony) Pike, Acoustics Specialist, Westland Helicopters.


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“The view expressed are those of the authors and should not be taken as representative of Westland Helicopters.”
BACKGROUND
• Rotorcraft have poor public acceptance –
  “Rotorcraft are not liked!”
• Low public acceptance is a major impediment to
  the expansion of operations and development of
  heliports/vertiports.
• How can public perception be changed?
• What are the real issues?
Questions

• Why is there a major difference of opinion?

• How can we ‘understand’ the impact and move forward?

• Normally considered that poor public acceptance is directly related to the noise impact…is this true?

• Does EPNL (EPNdB) adequately address noise from public acceptance?

• Is only the sound within the ’10dB-down’ period important?
Public Acceptance

• Why is there a debate??

• Evidence available suggests helicopters are 10-15dBA more annoying than other aircraft (for the same or lower measured sound level)

• Irrespective of the sound level measured the sound from helicopters is generally considered annoying

• Is public acceptance the main factor when considering ‘land use planning’ or is it the measured ‘noise certification’ sound level?

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Flyover Noise

BVI – Blade Vortex Interaction

TRI - Tail Rotor (Main Rotor Wake) Interaction

![Diagram showing sound pressure level over time for different scenarios of BVI and TRI]

- Helicopter with High Tail Rotor Noise, High TRI or High BVI
- Helicopter with no BVI, no TRI and Low Tail Rotor Noise
UK/CAA Social Survey

Social Survey Results

Social Surveys in London

1982 study
mainly small helicopters + S61 Heathrow-Gatwick ‘link’

1992 study
mainly small helicopters
Mainly Large Helicopters
Puma’s + S61’s
Additional Studies

• Resorts International – S61: New York–Atlantic City-1980’s
• Pan Am (W30/Bell 222) Operations – New York 1980’s.
• HAI information/history on complaints/comments.
• UK (BHAB) information.
• Inputs from Hawaii and Grand Canyon.
• Helijet – Victoria/Vancouver [Current Operation].
PUBLIC ACCEPTANCE
Public Acceptance

Acoustic (Noise)

Maximum Noise Level [EPNdB / SEL-dBA ]

Noise Levels in the “Maximum – 10 dB Down” range
Public Acceptance

Acoustic (Noise)

Noise Characteristics
At Distance

Maximum Noise Level
[EPNdB / SEL-dBA]
Public Acceptance

Virtual Noise (Non-Acoustic)

Acoustic (Noise)

Noise Characteristics
*At Distance*

Maximum Noise Level [EPNdB / SEL-dBA]
Public Acceptance

Virtual Noise (Non-Acoustic)

Acoustic Trigger

Acoustic (Noise)

Noise Characteristics At Distance

Maximum Noise Level [EPNdb / SEL-dBA]
Public Acceptance

Virtual Noise (Non-Acoustic)

Acoustic Trigger

Acoustic (Noise)

Noise Characteristics
At Distance

Maximum Noise Level
[EPNdb / SEL-dBA ]
• **Virtual noise** is triggered by the sound heard as rotorcraft approaches or flies by - response dependent on ‘character of sound’ [impulsive main rotor noise/BVI, TRI and high tail rotor noise provokes highest response]

• **Virtual noise** impact is much lower if triggered by sound without pronounced characteristics; this occurs on rotorcraft with low levels of impulsive main rotor noise/BVI, TRI and/or tail rotor noise. [These noise sources are also less pronounced on all rotorcraft in the “10 dB-down period.”]
Public Acceptance

Virtual Noise (Non-Acoustic)
- Acoustic Trigger

Acoustic (Noise)
- Noise Characteristics At Distance
- Maximum Noise Level [EPNdB / SEL-dBA]
Public Acceptance

Virtual Noise (Non-Acoustic)

Acoustic Trigger

Noise Characteristics At Distance

Acoustic (Noise)

Maximum Noise Level [EPNdB / SEL-dBA]

Visual Trigger
Public Acceptance

Virtual Noise (Non-Acoustic)

Visual Trigger

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Public Acceptance

Virtual Noise (Non-Acoustic)

Acoustic Trigger

Noise Characteristics At Distance

Acoustic (Noise)

Maximum Noise Level [EPNdb / SEL-dBA ]
• Level of *Virtual Noise* dependent on numerous factors including: -

  - Fear of crashes.
  - Lack of appreciation of need and positive impact on local economy.
  - General feeling that public concerns about noise (and safety) are ignored.
  - Feeling that there is no control of rotorcraft when flying (this is partly a result of the fact that fixed routes are not used).

*Note: public do not understand helicopter operations, autorotation capability or fact that many helicopters are multi-engine with ‘OEI’ enroute capability.*
‘Virtual Noise’ Levels

- Effect in terms of the equivalent A-weighted sound pressure level:
  - Negative reaction to leisure flying: 5 dB(A) **
  - Poor community/airfield relations: 10 dB(A)
  - Fear of crashes: 10 dB(A) **
  - “Nobody acts on complaints”: 20 dB(A)
  - Aircraft are flying too low: 20 dB(A)

Note: these equivalences are not reversible; for example, reducing noise levels by 10 dB(A) will not remove the fear of crashes

UK Study based on general aviation aircraft which included some rotorcraft.


** Some suggest this is higher for rotorcraft
• Need for rotorcraft [Main Reason]
  – The public does not accept that there is a need for rotorcraft: the only exception is in the case of EMS/Medivac operations…..and even in this case there is some public resistance to the use of rotorcraft for EMS and in particular hospital-to-hospital transfers!

• Public generally considers that rotorcraft are only used by “people with money for joy-riding.”
  …Hence to many people the noise generated by rotorcraft is “needless noise”
NEEDLESS NOISE

The Negative Impacts of Helicopter Traffic in New York City and the Tri-State Region

December 1999

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Reaction to Rotorcraft Noise
Acoustic and Non-Acoustic**

Non-Acoustic Factors Equal or More Important

** Virtual Noise
Social Survey Results

Mainly Large Helicopters
Puma’s + S61’s
Flyover Noise

**Generalised Flyover Time History**

- **Background (Ambient) Noise**
- **TRI or Tail Rotor Noise**
- **Helicopter with High Tail Rotor Noise, High TRI or High BVI**
- **Helicopter with no BVI, no TRI and Low Tail Rotor Noise**

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Flyover Noise

GENERALISED FLYOVER TIME HISTORY

Sound Pressure Level - dB (Arbitrary Datum)

-40 -30 -20 -10 0

Time - Seconds

Helicopter with High Tail Rotor Noise, High TRI or High BVI

Helicopter with no BVI, no TRI and Low Tail Rotor Noise

TRI or Tail Rotor Noise
Flyover Noise

GENERALISED FLYOVER TIME HISTORY

Sound Pressure Level - dB (Arbitrary Datum)

- Helicopter with High Tail Rotor Noise, High TRI or High BVI
- Helicopter with no BVI, no TRI and Low Tail Rotor Noise

Tri or Tail Rotor Noise
Flyover Noise

GENERALISED FLYOVER TIME HISTORY

- TRI or Tail Rotor Noise
- Helicopter with High Tail Rotor Noise, High TRI or High BVI
- Helicopter with no BVI, no TRI and Low Tail Rotor Noise

Sound Pressure Level - dB (Arbitrary Datum)

Time - Seconds
TECHNICAL ISSUES
Differences Of Opinion

• ONLY THE SOUND WITHIN THE 10dB – DOWN PERIOD IS IMPORTANT

• THE CHARACTER AND LEVEL OF SOUND PRIOR TO THE ’10dB-DOWN’ POINT IS NOT IMPORTANT

• THE ‘CHARACTER OF THE SOUND FOR THE COMPLETE PERIOD IS OVER WHICH IT IS HEARD IS IMPORTANT

• IMPULSIVE (BVI) NOISE, TAIL ROTOR INTERACTION (TRI) NOISE AND TAIL ROTOR ARE VERY IMPORTANT
Differences of Opinion

- EPNL IS THE PREFERRED/ACCEPTABLE METRIC FOR RATING THE HELICOPTER SOUND FOR PUBLIC ACCEPTANCE

- THE ‘TONE CORRECTION’ PROCEDURE IN THE EPNL IS ADEQUATE TO ACCOUNT FOR THE CHARACTER OF HELICOPTER NOISE

- EPNL - WHICH ONLY ADDRESSES THE SOUND WITHIN THE ’10dB DOWN PERIOD’- IS NOT ADEQUATE FOR PUBLIC ACCEPTANCE

- THE CHARACTER AND LEVEL OF SOUND PRIOR TO THE ’10dB-DOWN’ POINT IS VERY IMPORTANT AND EQUALLY OR MORE IMPORTANT THAN THE EPNL LEVEL

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Differences Of Opinion

- EPNL FULLY ACCOUNTS FOR ANY IMPULSIVE/TONAL CHARACTER WHICH IS IMPORTANT
- THE TONE CONTENT IS ADEQUATELY ACCOUNTED FOR BY THE EPNL PROCEDURE
- THE IMPULSIVE CONTENT INCREASES THE DURATION AND THIS IS AN ADEQUATE MEASURE OF THE ‘IMPULSIVE CONTENT’ OF HELICOPTER NOISE
- THE ‘TONE CORRECTION’ INCORPORATED IN THE EPNL CALCULATING PROCEDURE WAS DEVELOPED FOR ‘FIXED-WING’ AND IS POOR MEASURE OF THE ‘TONAL CONTENT’ OF HELICOPTERS.
- THE DURATION OF THE ‘10dB-DOWN’ PERIOD IS NOT AN ADEQUATE MEASURE OF INPULSIVE NOISE

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Subjective Noise Studies

- Numerous psychoacoustic studies (at least 34) over the 1978/1985 time frame: most focused on impulsive main rotor noise. i.e. blade slap, blade bang or blade vortex interaction.

- No conclusive results
  - 18 supported need for correction
  - 12 did not indicate any need for correction **
    — NASA studies supported use of EPNL**

- Only 2 studies related to tail rotor noise **

** duration and tone correction in EPNL considered to be adequate

*** Tail rotor noise (unlike in Europe) not considered an important source in the USA!
• The case that EPNL is an adequate unit for accessing the public acceptability of helicopter noise is not supported by a review of the public response to helicopter noise.

• NASA determined that EPNL was adequate for rating helicopter noise: this was in connection with noise certification which measure of ‘source noise’ not public acceptance.
NASA Studies

- NASA studies suggested that EPNL (EPNdB) best metric for rating helicopter noise for noise certification purposes.
  - assumption: impulsive sources increase duration; thus taken into account by EPNL calculations.
  - ‘tone correction’ not really addressed in most studies.

- ICAO, strongly supported by the US (FAA), UK (CAA), France (DGAC) and others, agreed to use EPNL for noise certification on the understanding that the industry work to ensure that the sources of impulsive noise would be eliminated.
NASA – Proposed Studies

- NASA now recommends research to address **
  - relationship between “noticeability” and annoyance
  - relationship of duration* of noticeability with annoyance

[**Dr. Powell, NASA- AHS Annual Forum 2003**]

* complete duration, not the’10db-down’ duration

“Noticeability effectively means Public Acceptance”
CONCLUDING REMARKS
Study Results

- Non-Acoustic Factors (*Virtual Noise*) Equal or more important than the actual noise.

- The noise level and **character of the sound** heard at distance is more important than the noise level/character within the ‘10dB-down period’ both as it relates to *Virtual Noise* and the Acoustic impact of helicopters.

- There are no known methods (metrics) for fully rating helicopter noise that adequately address the **character** of the sound within or prior to the 10dB-down point. **

  ** By implication EPNL is not adequate for addressing public acceptance

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“Thank You”

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