Abstract

The airport project is one of the development projects on the environmental impact assessment (EIA) requested list by law in Thailand. The airport noise impact assessment procedures are selectively proposed by a consultant whom conducts the EIA reports for the airport development project, freely. Airport noise assessment procedures have been following the Noise Exposure Forecast (NEF) for more than 50 years, proposed by the American Consultant. There is none of any rules and regulations specifying the noise descriptor and its calculation for airport noise in Thailand. NEF is now a current noise descriptor to contribute in the calculation of airport noise levels and their contours, making a proposed contour map for determining the airport noise mitigation measures and monitoring plan on the EIA report of the proposed airport development project and its expansion. Day-Night Noise Levels (L_{DN}) and Day-Evening-Night Noise Levels (L_{DEN}) using Sound Exposure Levels (SEL) measurement were also proposed to the land use compatibility consideration in the future. Their measurements and calculations have been on the research scales to propose specific rules on the calculation and measurement of airport noise assessment in Thailand.

Impact Assessment System for Airport Project in Thailand

The Environmental/Health Impact Assessment (E/HIA) process is required by the Section 67 (Community rights) of Constitution of the Kingdom of Thailand in accordance with the Enhancement and Conservation of the Environmental Quality Act B.E. 2535 (1992) on the specific projects, mandating on the Notification of Ministry of Natural Resources and Environment on the requirements on type and size of the project or activities, conducting the environmental impact assessment report and rules, methodologies, work instructions, and guideline on the environmental impact assessment report, dated on 16th June 2009 [1], the Notification of Ministry of Natural Resources and Environment on Rules, Procedures, Method and Guideline for Preparation of the Environmental Impact Assessment Report for Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resource and Health, dated on 29th December 2009 [2][3], and the National Health Act B.E.2550 (2007) on the Rules and Procedures for the Health Impact Assessment of Public Policies (2009) [4], including the all types of airport projects to conduct airport noise impact assessment.

In addition, there are other two requirements to comply with the Section 67 of the Constitution: the public participation process and the consultation and reviewing process by the Independent Organization on Environment and Health (http://www.iceh.or.th) which the project owner to seek prior to approval of relevant authorities for issuing licenses. The public participation process shall be conducted at least in compliance with the Guideline for Consultation with the Public and Interested Parties in the Process of Environmental Impact Assessment for Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resources and Health.[5][6]

Meanwhile, the Independent Organization on Environment and Health Committee has been already established in correspondence with the draft law on the Independent Organization on Environment and Health Act. The Office of the Independent Organization on Environment and Health is now under establishment process since the beginning of this year. The new review process is now under consideration and development. The overview of fundamental right to live in healthy environment and environmental conditions in Thailand is shown in Figure 1-1 as related to the required process (4 requirements) for any airport projects to take into account for seeking prior to approval of licensing from the relevant authorities.

Environmental/Health Impact Assessment Process (E/HIA Process) for Airport Noise

Any airport projects shall be complied with all of four requirements, mandated by the Constitution and other related regulations and guidelines as mentioned above. The EIA process, HIA process, public participation process, and independent experts review process shall be fulfilled in order to seek for approval of licensing from relevant authorities. Airport noise is one of the key pollutants in the E/HIA process of the airport project both in the construction and operation stages. The airport owner shall take a responsibility to prepare the E/HIA report or to contract out the consultants to prepare it for them. The experienced consultants (personnel) shall be licensed by the ONEP approval. The airport owner shall submit the proposal and terms of references of airport project to the Thai Cabinet for their initial approval concurrently with the ONEP recommendation on the E/HIA preparation. Then, the E/HIA report will be carried out under the given recommendations from the ONEP in the following of the relevant regulations and guidelines.
The general four tiers system: physical resources, biological resources, human utilities, and human quality of life of the environmental impact assessment process are definitely applied for EIA of airport project. There are four steps: the study of existing conditions of noise in the vicinity of airport, the airport noise impact assessment and scenarios analysis, the mitigation measures, and the noise monitoring plans shall be conducted, comprising of the four tiers component in the EIA report. The details of airport noise data collection, data analysis, input data for airport noise prediction model, baseline data and noise limits, and other will be provided for impact analysis and the appropriated noise descriptor, noise monitoring data, meteorological data, aircraft types and traffic volume, aircraft noise prediction methods, and other relevant factors shall be collected and analyzed in the existing condition in comparison with the noise impact assessment using the appropriated model and assessment techniques. The mitigation measures and monitoring plans will be mapped out and proposed using the analyzed data above. The details of practical guidance of EIA process in related to airport noise issue are described as shown in Figure 1-2.

The 24-hour Equivalent Continuous Sound Pressure Levels ($L_{eq,24hr}$ in dBA) is typically applied for the noise measurement in the existing, the predicted, and monitoring noise levels in the EIA report, including the Maximum Sound Pressure Levels ($L_{max}$ in dBA), Statistical Levels ($L_{eq}$ in dBA), and Sound Exposure Levels ($L_{ex}$ or SEL in dBA) which are including the environmental noise with fly-over aircraft noise components that unclearly identifying the contribution of aircraft noise levels heard on the ground. While the Noise Exposure Forecast (NEF) is practically using in the noise prediction process in order to put down the noise exposure map or noise contour map and the considered mitigation measures on noise management in the vicinity of the airport in comparison with the NEF criteria (Table 1-1) without any relevant regulations. The INM model created by the US.FAA is commonly adopted in the airport noise prediction process in Thailand. The needed input data for INM model shall be prepared for its calculation. The noise contour map with the prescribed noise descriptor will be easily plotted into visible format, readily overlaying with the various types of map on topography, land use plan, or population/sensitive receptors, etc to propose the appropriated mitigation measure and monitoring plans.

Since 2009, the HIA process was required for the airport project in Thailand in terms of one of the serious impacts on environment and health. It is comprised of six steps: data preparation, public screening, health impact assessment, public review, review and decision making, and monitoring and evaluation. There are two types of noise effects on human health: physical and psychological noise effects. Both effects will be provided, analyzed, and evaluated in the HIA systematically in order to put down the mitigation measures and its protection, including the monitoring plans. The sensitive receptors will be identified and proposed the most appropriated mitigation measures to be implemented during the operation stage of the airport. The details of HIA process on the airport noise issue are illustrated in Figure 1-3.

The E/HIA report will be occasionally informed to public during the public participation process within the E/HIA process requirement by applicable regulation and guideline. The E/HIA report, including with the public participation report will be submitted collectively to the ONEP for the experts committee review to seek for an approval by the NEB prior to searching for relevant licenses. The technical review process will be conducted by the ONEP for seeking the expert opinion and recommended conditions from the experts committee. The experts committee on the transportation project will be considered the E/HIA report of the proposed airport projects under the Section 48-52 of the EPEQA B.E.2535 (1992). The decision making power on the E/HIA report approval is of the NEB mandated by the EPEQA B.E.2535 (1992). When the approval of the NEB was executed, it will be proposed to seek for the Cabinet approval to launch the project. (Figure 1-2)

### Table 1-1 Noise Exposure Forecast for Airport Project

<table>
<thead>
<tr>
<th>NEF</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30</td>
<td>None of any airport noise effects and mitigation measures</td>
</tr>
<tr>
<td>30-35</td>
<td>Airport noise affected areas, noise insulation shall be applied</td>
</tr>
<tr>
<td>35-40</td>
<td>More severe airport noise affected areas, noise insulation or other mitigations shall be applied</td>
</tr>
<tr>
<td>&gt;40</td>
<td>Most severe airport noise affected areas, none of any residential areas or sensitive receptors allow to be inside of this areas, the compensation or land purchase shall be applied</td>
</tr>
</tbody>
</table>

Sources: EIA report of the new Bangkok International Airport (2002) [7]

In Thailand, airport noise monitoring program was taken into account of the proposed mitigation measures and monitoring plan in the EIA post-auditing process of all airport projects, particularly in airports with large number of air traffic volume such as international airports. The airport noise monitoring programs will be conducted by the discrete environmental noise with the contribution of the aircraft flyover noise twice or three times a year in order to submit the post-auditing report to the ONEP. Its practical noise monitoring method, declared in the post-auditing report, applies only the Equivalent Continuous Sound Pressure Levels ($L_{eq}$) of overall environmental noise levels perceiving by receptors’ surrounding, including the aircraft noise components. The calculated $L_{eq}$ taken into account of the fly-over aircraft noise events were unclearly identifying on the process of the practical noise monitoring method, declared in the post-auditing report.

The international air transportation hub was one of the most competitive factors of each state, particularly in the economic returns in a small region like South-East Asian. Airport project and its expansion shall be carried out without any obstacles. The complaints from the community nearby may cause important obstacles of airport expansion.
like in other big and dense cities, reducing the potential of getting more economic returns. The E/HIA process will be one of the powerful tools to reinforce the competitiveness of the Suvarnabhumi Airport on the airport expansion in the near future.

What are the Future Considerations of the Airport Noise Assessment in the E/HIA process in Thailand?

The airport noise levels around international airports are separately conducted and reported by each of the EIA post-auditing report annually in order to submit to the ONEP review and storage in the data monitoring collection. The permanent noise monitoring system are procured and installed in the airfield and the vicinity of the proposed airport before its operations to fulfill a database system of airport noise for the public disclosure, particularly the maximum utilization of the international recommendations on the “ICAO Balanced Approach” within an appropriated way.[9] Without the permanent aircraft fly-over noise monitoring system, none of any precise predicted airport noise data for airport planning, evidence for noise surcharges on violation of the flight procedures, accurate noise map for zoning and compensation allocation were not generally possible to be acquired.

The difficulties were found out by what criteria will be equally taken into account in the allocation of remedies and compensations in noise abatement programs—i.e. which noise exposure map shall be applied for remedy and compensation allocation, which descriptors and calculation methods shall be applied for qualified determination on noise exposure mapping, how many inhabitants shall be eligible to receive the remedy and compensation, etc. without any of the appropriated regulations and guidelines from the relevant authorities.

However, the noise measurement program in the vicinity of the proposed airports will be conducted by means of the $L_{eq,24hr}$, $L_{dn}$, $L_{max}$ of each sensitive receptors in order to do the noise monitoring reports, required by the EIA requirements under the EPEQA B.E.2535 (1992). Unfortunately, there are none of the fact finding instruments to fulfill a database system of airport noise at Suvarnabhumi Airport for the public disclosure. The permanent noise monitoring system as mentioned in the EIA monitoring plan conditions of the Suvarnabhumi airport are now still under installation and testing run stage of the system.

The new E/HIA process has been introduced to airport projects under the Section 67 of the Thai Constitution 2007, including the airport noise impacts assessment. Meanwhile, the recommended standards of measurement and determination on the environmental noise issues in the ISO 1996 series [10][11], and the unattended monitoring of aircraft sound in the vicinity of airports in the ISO 20906:2009 [12] were completely published for voluntarily adopting into domestic application on the airport noise management. In addition, the flexible various of policy and legal instruments, outlined by the Chicago Convention in compliance with the “ICAO Balanced Approach” of Annex 16 Volume I [13], shall be beneficially implemented into the future expansion on the airport noise management plan at Suvarnabhumi airport relevant to its related factors on noise abatement measures.

The implementation of the “Balanced Approach” will not be easy in practice. Evidently, the noisy aircraft phase-out program was technically the most difficult approach in Thailand because it took more than a decade in following of the Chicago Convention. Another difficult factor to achieve is the land use compatibility. Though the land use planning is the most delicate issue, it is the most powerful fundamental influence not only noise reduction but also other pollution mitigation. Therefore, the land use compatibility programs shall be immediately taken into action in gradually manners along with the airport expansion and future airport noise management.

Furthermore, the noise monitoring system is the most important instruments to support the existing airport noise database using for noise prediction model verification, making the noise contour map for achieving existing and future noise impacts, analyzing the best solution for noise abatement departure procedures, choosing the preferential runway, taking taxes or charges from noisy aircraft in equal practical manners. The aircraft flyover noise monitoring, generally implemented by the airport noise monitoring system, shall be correctly in compliance with the ISO 20906:2009 in order to provide the databank of the existing aircraft noise data for future expansion, noise impact analysis, and noise abatement programs.

All of the international recommendations on the airport noise management as mentioned above shall be taken into consideration as the good practices among the relevant authorities in Thailand on the E/HIA process to propose the better airport noise management plans for the future expansion of the airport in the near future, particularly the Day-Night Noise Levels ($L_{dn}$) and Day-Evening-Night Noise Levels ($L_{eq}$) using Sound Exposure Levels (SEL) measurement of the single events of aircraft fly-over. The airport noise relevant agencies are now working together to discuss and draft the specific guidelines on airport noise measurement and assessment. It will be taken into action in the next two years.

Acknowledgement

We would like to give our sincere gratitude to Dr. Ichiro Yamada for his encouragement and support including an opportunity to have the contribution on this paper. This paper will not be accomplished without support and constructive comment from Prof. Dr. Lawrence S. Finegolds and Prof. Dr. Michiko So Finegolds, Dr. Suntariya Muanpawong.

References

[1] The Notification of Ministry of Natural Resources and Environment on the requirements on type and size of the project or activities, conducting the environmental impact assessment report and rules, methodologies, work instructions, and guideline on the environmental


[5] Guideline for Consultation with the Public and Interested Parties in the Process of Environmental Impact Assessment for Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resources and Health<http://www.erc.or.th/EHIA/Upload/Document/Article/9_%E0%B8%84%E0%B8%B9%E0%B9%88%E0%B8%A1%E0%B8%B7%E0%B8%AD%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B8%8A%E0%B8%B2%E0%B8%8A%E0%B8%99.pdf>access 11th November 2011


### Consideration by Relevant Authority upon Issuing License

Under the Community Rights in Section 67 of the Thai Constitution of the Kingdom of Thailand

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<tr>
<td>Responsible authorities: ONEP/NEB</td>
<td>Responsible authorities: NEB/ONEP/NHC/NHCO</td>
<td>Relevant authority</td>
<td>Temporary Committee and Office</td>
</tr>
</tbody>
</table>

**Remarks:**
- Thai Constitution of the Kingdom of Thailand (Present issue: B.E.2550 (2007))
- NEB: National Environmental Board
- ONEP: Office of Natural Resources and Environmental Policy and Planning
- NHA: National Health Act B.E.2550 (2007)
- NH: National Health Commission
- NHC: National Health Commission Office
- Guideline for Consultation with the Public and Interested Parties in the Process of Environmental Impact Assessment for Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resources and Health

**AIRPORT PROJECT** is one of the required project to be applied for the process under the Section 67 on the Thai Constitution of the Kingdom of Thailand in accordance with the Notification of Ministry of Natural Resources and Environment on Rules, Procedures, Method and Guideline for Preparation of the Environmental Impact Assessment Report or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resources and Health, dated on December 29th, 2009.

**Figure 1-1** Overview of the Fundamental Right to Live in Healthy Environment and Environmental Conditions in Thailand (Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resource and Health)
Government Agencies/State Enterprise (Project Owner) submit Terms of References (TOR) of the Proposed Project to the Office of Natural Resources and Environmental Policy and Planning (ONEP) for asking ONEP opinion on EIA process

Project Owner/Consultant Conduct the EIA Report (Starting from the Feasibility Study Stage) and submit to ONEP for experts review and approval

**Environmental Impact Assessment Process for Airport Project**

(Focused on Airport Noise Assessment)

### Existing Condition (Primary data and secondary data)
- **Mitigation Measures**
  - Prediction Model Selection
  - Aircraft noise prediction model (US-FAA INM model commonly applied for airport noise impact assessment process in Thailand)
- **Data Collection**
  - None of any data collection

### Environmental Impact Assessment
- **Input data for prediction model**
  - Noise levels (L90, Lmax, SEL, Leq, L90)
- **Environmental Quality Standards and other related regulations**
  - Noise Exposure Forecast (NEF) applied by practical technical review committee on EIA process
- **Technique for Assessment**
  - Comparison
  - Checklists/Matrices
  - Statistics analysis
  - Scenarios building
  - Map overlaying
  - Expert opinion

### Environmental Quality Standards and other related regulations
- None of specific standards for airport noise
- Noise levels for hearing loss protection (Leq,24hr ≤ 70 dBA)
- Annoyance noise standards (Leq,1hr – L90 ≤ 10 dBA)

### Results and Scenarios
- Overall predicted noise levels at sensitive receptors and receptors
- Noise affected population density/household
- Worst case
- Best case
- Alternatives
- Recommendations for noise mitigation measures and management plan

### Mitigation Measures
- Chapter 3 or better of Low noise aircraft (ICAO Annex 16: Volume I Aircraft Noise)
- Noise abatement flight instruments (Departure & Arrival)
- Airport noise zone/flight curfew
- Airport/aircraft noise charges or levies

### Data Collection for Human Utilities
- Compensation for noise effected relocation
- Insurance program for sensitive receptors
- Remedy for noise affected household for insurance program
- Remedy Agreement
- Sensitive receptors

### Data Collection for Human Quality of Life
- Compensation for hearing loss receptors
- Hearing protection/conservation program

### Data Collection for Physical Resources
- Aircraft types with air traffic volume in day-night time
- Runway use
- Departure-Arrival Instrument Pattern and Direction (Route)
- Airport/Runway data description
- Noise monitoring station
- Sensitive receptors

### Data Collection for Biological Resources
- None of any measures

### Data Collection for Monitoring on Physical Resources
- Noise levels in Sound Exposure Levels (SEL)
- Leq,24hr (1min) of overall aircraft flyover at receptor point
- Lmax, Lmin, L90
- Meteorological data
- Flight volume by aircraft types, time of day, flight path/runways

### National Environmental Board (NEB) submit their opinion to the Cabinet

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**Figure 1-2** Environmental Impact Assessment (EIA) Process for Airport Project in Thailand
Remarks:
(1) Prepare HIA Report: Based on Ministry of Natural Resources and Environment (MoNRE) guideline issued on December 29, 2009 (Duration depends on each project) under the Notification of MoNRE on Rules, Procedures, Method and Guideline for Preparation of the Environmental Impact Assessment Report for Project or Activity which may Seriously Affect Community with Respect to Quality of Environment, Natural Resources and Health (2) Overview of the HIA process, particularly the health impact assessment of public policies are mandated by the Thailand’s Rules and Procedures for the Health Impact Assessment of Public Policies 2009 under the National Health Act 2007

Figure 1-3 Health Impact Assessment (HIA) Process for Airport Project in Thailand