Consideration of Human health Risk Assessment for ELA in China

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Presentation Summary

- Overview of Chinese EIA and Human Health Risk Assessment (HHRA)
- Objective of Study
- Technical Scope of Study
- Case Study - EIA Example with HHRA Consideration in China
Definition of EIA

‘Evaluation of environmental effects mentioned in this Law consists of the analysis, prediction and assessment made of the possible environmental effects after implementation of plans and completion of construction projects, ways put forth and measures for preventing or mitigating the adverse effects on the environment, and the methods and systems applied for follow-up monitoring’

---- Law of Environmental Impact Assessment in China

Environmental Quality Standards and Pollutants Emission and Discharge Standards are basis of environmental effects evaluation
Definition of HHRA

“The scientific evaluation of potential health impacts that may result from exposure to a particular substance or mixture of substances under specified conditions’

Chemical benchmark are basis of evaluation of human health risk

- The USEPA has established several protocols to address human health risk from different source and with different exposure pathways
Multi-pathway Exposure for HHRA
Objective of Study

- Introduction of human health risk assessment (HHRA) in China
- Possibility research of applying HHRA to EIA in China
- Rationality of HHRA for the result of EIA in China
- Promotion of EIA in China and focus EIA more to the impacts on Human Health Risk
Technical Scope of Study

- Characterizing Facility Emissions
  - Identifying Emission Sources & Developing Emission Inventory (i.e., emission rate)
  - Identifying the Compounds of Potential Concern (COPCs)

- Air Dispersion and HHRA Modeling
  - Terrain, land use data collection and preprocessing
  - Meteorological data collection and preprocessing
  - AERMOD model running
  - HHRA Model running
An EIA Example with HHRA Consideration

For a Ceramics Plant in Zhejiang Province, China
EIA Process

Plant Characterization
- Basic Plant Information
- Emission Sources and Rates
- Identifying COPCs

Dispersion Modeling
- AERMOD Site Specific Parameters
- Modeling over watershed

Modeling Result Analysis
- Environmental Quality Standard
- Post-processing

Exposure Scenario
- Recommended Scenarios
- Scenario Locations

Identifying and Interpreting Uncertainty
- Qualitative and Quantitative

Risk and Hazard Characterization
- Calculating Noncancer Hazard

Quantifying Exposure
- Inhalation, exposure duration, frequency
Data Preparation

- Emission Inventory
- Compound Data
- State Standard & Benchmark
- Meteorological Data
- Terrain Data
- Location & Layout
Cancer Risk and Hazard Quotient

- **Individual Cancer Risk (Indirect Exposure, Carcinogens):**

  \[ Cancer\ Risk_i = \frac{I \cdot ED \cdot EF \cdot CSF}{AT \cdot 365} \]

- **Hazard Quotient (Non-Carcinogens)**

  \[ HQ = \frac{I \cdot ED \cdot EF}{RfD \cdot AT \cdot 365} \]

- Where,
  - \( I \) = Daily intake of a COPC, mg COPC/kg BW-day
  - \( ED \) = Exposure duration, yrs
  - \( EF \) = Exposure Frequency, days/yr
  - \( AT \) = Averaging Time, yrs
  - \( CSF \) = Cancer Slope Factor (COPC specific value), (mg/kg-day)^{-1}
  - \( RfD \) = Reference Dose (COPC Specific value), mg/kg-day
Total Cancer Risk and Hazard Index

- **Individual Cancer Risk (Indirect Exposure, Carcinogens):**

  \[ \text{Total Cancer Risk} = \sum_i \text{Cancer Risk}_i \]

  - Total Cancer Risk is the sum of cancer risk for all ‘i’ COPC carcinogens

- **Total Hazard Index (Non - Carcinogens):**

  \[ \text{Total Hazard Index} = \sum_j \text{HI}_j \]
  \[ \text{HI} = \sum_i \text{HQ}_i \]

  - Hazard Index (HI) is the sum of hazard quotients for all ‘i’ non – carcinogenic COPCs through a single pathway
  
  - Total Hazard Index is sum of hazard indices across all ‘j’ pathways
HHRA Modeling

Modeling Platform -- BREEZE® Risk Analyst

- A human health and ecological risk assessment modeling system
- Conduct multi-pathway human health risk assessments and food-web based ecological risk assessment modeling.
EIA Result

AERMOD Result (ug/m³)

Human Healthy Risk Contour
Comparison of AERMOD and HHRA

Dispersion and HHRA Analysis for H$_2$S

Concentration, µg/m$^3$

H$_2$S

0 0.1 0.2 0.3 0.4

114 72 810 788 749 701 681 195 710 667 679 617 584 506 283 439

CONCENTRATION
HAZARD
Summary

- This case study illustrates the application of HHRA model to analyzing human health risk for an EIA project in China.
  - Current conditions and parameters for EIA satisfy the HHRA data requirements. With the HHRA, it improves the EIA analysis with quantitative risk assessment.

- Challenges for HHRA Application in China
  - Data for HHRA Modeling
  - Unified Law and Regulation for HHRA
Thanks!

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