Laurentian University
Université Laurentienne

Final Project Report

HAZARD IDENTIFICATION, RISK ASSESSMENT, ANALYSIS, MANAGEMENT AND RECOMMENDATIONS FOR MITIGATING THE RISKS ASSOCIATED WITH WORKPLACE HEALTH AND SAFETY HAZARDS

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Submitted by:

Name	Student ID
Md Jahangir Alam	0425538
Shahariar Hossain	0436595
Mohammad Fahim Tahmid Shahriar	0430886
Alejandro Quintana Rojas	0436198
Tony Kpai	0445330

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Submitted to
Pro. Philip Dirige, PhD, PEng
Adjunct/Sessional Faculty, Bharti School of Engineering,
Laurentian University

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1. Introduction

This project report is intended to identify hazards, assess risks, and provide recommendations to reduce health and safety risks related to the core cutting operations performed in Core Cutting Shacks #1 and #2. Based on recently conducted industrial hygiene surveys at both locations for noise exposure and respirable dust concentrations, including crystalline quartz silica, this report explains various risks.

This core cutting process is one of the critical operations associated with diamond drilling operations, having the potential to affect the health and safety of workers. The objectives were identification of industrial hygiene issues, risk assessment, root-cause analysis of priority hazards, and recommendations to mitigate associated risks. Noise exposure, respirable dust, and crystalline silica concentrations were surveyed in core cutting shacks. The paper identifies existing controls, profiles the risks quantitatively through a risk matrix, defines top events using the Bow Tie method, and provides relevant recommendations to mitigate identified health and safety hazards.

2. Hazard Identification - (Recognize It)

Workplace high level hazards categories

1. Physical Hazards:
    - Contact with rotating core cutting machinery.
    - Slips, trips, and falls due to uneven or slippery surfaces.
    - Falling objects from shelves or racks.
    - Exposure to sharp cutting tools and diamond core bits.
2. Chemical Hazards:
    - Use of lubricants, coolants, or cutting fluids that may be hazardous if mishandled.
    - Cleaning agents or solvents with potential health risks.
3. Ergonomic Hazards:
    - Repetitive motions while operating core cutting machines.
    - Poor workstation design leading to discomfort or musculoskeletal issues.
4. Electrical Hazards:
    - Malfunctioning electrical equipment.
    - Improper use of electrical tools and extension cords.
5. Fire and Explosion Hazards:
    - Combustible materials stored improperly.
    - Electrical sparks near flammable substances.
6. Noise Hazards:
    - Prolonged exposure to high noise levels from core cutting machines.
7. Confined Space Hazards:
    - Risks associated with working in confined spaces while core cutting.
8. Respirable Dust and Silica Hazards:
    - Respirable dust containing crystalline quartz silica is produced during core cutting, which can pose serious health risks if inhaled by workers.

9. Environmental Hazards:
    - Dust generation from core cutting operations. Waste disposal and potential environmental impacts.
10. Biological Hazards:
    - If applicable, risks associated with biological materials or waste.
11. Personal Protective Equipment (PPE) Requirements:
    - Ensuring appropriate PPE for employees, including safety goggles, gloves, hearing protection, and respiratory protection.
12. Training and Knowledge:
    - Adequate training for employees on core cutting procedures, equipment use, and emergency protocols.
13. Emergency Preparedness:
    - Having procedures in place for medical emergencies, equipment failure, fire, or other incidents.
14. Security Concerns:
    - Safeguarding valuable equipment and materials from theft or unauthorized access.
15. Maintenance and Inspections:
    - Regular checks and maintenance of core cutting machinery to prevent breakdowns and accidents.
16. Material Handling:
    - Proper lifting and handling techniques to avoid strains and injuries.

The hazards identified for core cutting in both shacks are as follows:

2.1 Noise Hazards: The core cutting machinery, air sampling pumps, the exhaust ventilation fan, and the vacuum system are all very noisy. The noise is excessively long, which can result in a potential hearing problem, causing stress and decreased levels of concentration. Additionally, noise from adjacent locations has a disturbing effect on workers due to the closed door, reducing the noise level.

2.2 Respirable Dust and Silica Hazards: Crystalline quartz silica in respirable dust may be generated in the process of core cutting, which can potentially cause severe health problems in the lungs of workers in case of inhalation. The principal health effects related to respirable dust and silica exposure are excess mortality from respiratory diseases, silicosis, lung cancer, and nonmalignant respiratory disease (COPD).

Industrial Hygiene Test Results:
2.1 Noise:
- Core cutting shack #1: The average sound level during core cutting was 105.4 dB, exceeding allowable exposure limits. Mandatory double hearing protection is required.
- Core cutting shack #2: The average sound level during core cutting was 105.0 dB, also exceeding allowable exposure limits. Mandatory double hearing protection is required.

2.2 Respirable Dust and Silica:

- Core cutting shack #1: The average respirable dust concentration was 1.30 mg/m3, exceeding the OEL of 3.0 mg/m3. The average crystalline silica concentration was 0.0584 mg/m3, below the OEL of 0.10 mg/m3.
- Core cutting shack #2: The average respirable dust concentration was 2.40 mg/m3, exceeding the OEL of 3.0 mg/m3. The average crystalline silica concentration was 0.0033 mg/m3, below the OEL of 0.10 mg/m3. Risk Assessment Process: 3.1 Hazard Identification:
- Core cutting shack #1: High noise exposure, excessive respirable dust.
- Core cutting shack #2: High noise exposure, excessive respirable dust.

3. Existing Controls

3.1 Noise Control:

Core Cutting Shack #1:

- The operator uses earmuffs for hearing protection, but additional measures may be required due to the high noise levels.

Core Cutting Shack #2:

- The use of earmuffs by the operator provides hearing protection.

3.2 Respirable Dust and Silica Control:

Core Cutting Shack #1:

- Intake air from the ceiling above the operator provides a source of fresh air.
- Exhaust ventilation located on the side wall removes airborne contaminants.
- Water is used to control airborne contaminants during core cutting, which helps to reduce the spread of respirable dust and silica.

Core Cutting Shack #2:

- The exhaust ventilation located at the end of the room exhausts outside, potentially reducing noise levels.
- The fitted respirator used by the operator protects against dust and silica exposure.
- Water is used to control airborne contaminants during core cutting, which helps to reduce the spread of respirable dust and silica.

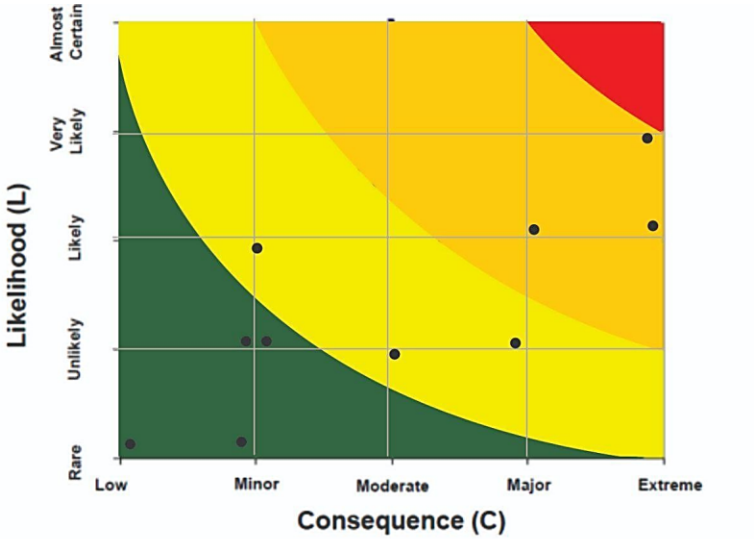
4. Risk Assessment

Risk Registry for Core Cutting Operations in Core Cutting Shacks #1 and

Activity/ Process/ Task	Hazard	Incident	Consequences	Likelihood of Incident	Severity of Consequence	Risk Assessment	Priority	Pre-Incident Control	Post-Incident Control	Residual Risk
Core Cutting Operation #1	Prolonged exposure to high noise levels	Hearing loss	Fatality or Permanent Disability	4 (Very Likely)	5 (Extreme)	20	High	- Intake air from the ceiling above the operator. - Exhaust ventilation located on the side wall near the cutter. - Vacuum system for airborne contaminants. - Use of earmuffs for hearing protection.	- Explore additional noise dampening techniques or enclosures for the cutter to reduce noise propagation. - Conduct regular hearing assessments for the operator to detect early signs of hearing loss.	Low
Core Cutting Operation #2	Exposure to respirable dust with crystalline silica	Respiratory illnesses	Fatality or Permanent Disability	3 (Likely)	5 (Extreme)	15	High	- Water-based control system to suppress dust during cutting. - Use of local exhaust ventilation to capture and remove dust at the source. - Workers wearing fitted respirators with proper training.	- Enhance the water-based control system. - Implement local exhaust ventilation with improved efficiency. - Conduct regular fit testing and provide refresher training on respirator usage.	Medium
Core Cutting Operation #3	High noise levels during core cutting operations	Hearing impairment	Serious Event/Critical Injury or Critical Illness	3 (Likely)	4 (Major)	12	Medium	- Regular maintenance and soundproofing of machinery. - Use of earmuffs or earplugs by workers. - Installation of noise barriers.	- Continue with current preventive control measures. - Conduct regular equipment maintenance and optimize soundproofing.	Low
Core Cutting Operation #4	Exposure to general respirable dust	Respiratory Intention	Temporary Disability (Lost Time); Injury/Illness	2 (Unlikely)	3 (Moderate)	6	Medium	- Use of general ventilation systems to reduce dust concentration. - Workers wearing dust masks. - Regular cleaning and dust control measures.	- Implement local exhaust ventilation near dust sources. - Provide more efficient respiratory protection. - Improve dust control measures.	Low

Core Cutting Operation #5	Noise disruption to workers at adjacent locations	Disruption in workflow	First Aid Treatment (No Lost Time)	3 (Likely)	2 (Minor)	6	Medium	- Communication of core cutting schedules to adjacent work areas. - Use of temporary barriers to reduce noise transmission.	- Continue with current preventive control measures. - Explore additional measures to minimize noise propagation.	Low
Core Cutting Operation #6	Exposure to respirable dust during core cutting	Respiratory discomfort	First Aid Treatment (No Lost Time)	2 (Unlikely)	2 (Minor)	4	Low	- Use of local exhaust ventilation during core cutting. - Workers wearing dust masks.	- Enhance the local exhaust ventilation system. - Provide more efficient respiratory protection.	Low
Core Cutting Operation #7	Noise disturbance due to core cutting operations	Disruption to nearby activities	First Aid Treatment (No Lost Time)	2 (Unlikely)	2 (Minor)	4	Low	- Use of noise-dampening measures for core cutting machinery.	- Continue with current preventive control measures. - Explore additional noise-dampening techniques.	Low
Core Cutting Operation #8	General exposure to dust particles	Respiratory irritation	No Injury or illness (or negligible impact/importance)	1 (Rare)	2 (Minor)	2	Low	- Regular cleaning and dust control measures. - Workers wearing dust masks.	- Implement additional local exhaust ventilation to reduce overall dust levels. - Provide more efficient respiratory protection.	Low
Core Cutting Operation #9	Exposure to respirable dust without silica	Respiratory discomfort	No Injury or illness (or negligible impact/importance)	1 (Rare)	1 (Low)	1	Low	- Use of general ventilation systems to reduce dust concentration. - Workers wearing dust masks.	- Implement local exhaust ventilation near dust sources. - Provide more efficient respiratory protection. - Improve dust control measures.	Low

Risk assessment heat map



LIKELIHOOD	DESCRIPTION
Almost Certain [5]	**Unwanted event is almost certain to happen in the next year** [or 90% or greater chance of occurrence]
Very Likely [4]	**High probability for unwanted event to occur in the next year** [or between 50%-90% chance of occurrence]
Likely [3]	**It is possible for unwanted event to occur in the next year** [or between 20%-50% chance of occurrence]
Unlikely [2]	**Low probability for unwanted event to occur in the next year** [or between 5%-20% chance of occurrence]
Rare [1]	**Very low probability for unwanted event to occur in the next year** [or less than 5% chance of occurrence]

CONSEQUENCE	DESCRIPTION
Extreme [5]	**Fatality or Permanent Disability** [or extreme impact/importance]
Major [4]	**Serious Event/ Critical Injury or Critical Illness** [or major impact/importance]
Moderate [3]	**Temporary Disability (Lost Time): Injury/Illness** [or moderate impact/importance]
Minor [2]	**First Aid Treatment (No Lost Time)** [or minor impact/importance]
Low [1]	**No Injury or Illness** [or negligible impact/importance]

5. Risk Rating and Hazard Ranking

Risk Rank	Category	Event	Likelihood	Consequence	Risk
1	Noise	Prolonged exposure to high noise levels	4(Very Likely)	5 (Extreme)	20
2	Respirable Dust	Exposure to respirable dust with crystalline silica	3 (Likely)	5 (Extreme)	15
3	Noise	High noise levels during core cutting operations	3 (Likely)	4 (Major)	12
4	Respirable Dust	Exposure to general respirable dust	2 (Unlikely)	3 (Moderate)	6
5	Noise	Noise disruption to workers at adjacent locations	3 (Likely)	2 (Minor)	6
6	Respirable Dust	Exposure to respirable dust during core cutting	2 (Unlikely)	2 (Minor)	4
7	Noise	Noise disturbance due to core cutting operations	2 (Unlikely)	2 (Minor)	4
8	Respirable Dust	General exposure to dust particles	1 (Rare)	2 (Minor)	2
9	Respirable Dust	Exposure to respirable dust without silica	1 (Rare)	1 (Low)	1

6. Improvement Requirements (Recommendations) for Control and Re-assessment

Prolonged exposure to high noise levels:

- Install additional noise barriers or soundproofing materials.
- Conduct a comprehensive noise assessment and implement engineering controls.
- Regularly maintain and calibrate noise-generating equipment.
- Provide training on hearing protection and earmuff usage.
- Periodically monitor noise levels to verify control effectiveness.

Exposure to respirable dust with crystalline silica:

- Enhance the water-based control system.
- Implement local exhaust ventilation.
- Regularly fit test respirators and encourage clean-shaven faces.
- Provide training on the hazards and proper use of personal protective equipment (PPE).

High noise levels during core cutting operations:

- Consider job rotation to reduce individual exposure time.
- Optimize scheduling to minimize noise impact on adjacent workers.
- Regularly maintain core cutting machinery for noise reduction.

Exposure to general respirable dust:

- Implement local exhaust ventilation near dust sources.
- Provide workers with appropriate respiratory protection.

Noise disruption to workers at adjacent locations:

- Communicate core cutting schedules to adjacent work areas.
- Use temporary barriers to reduce noise transmission.

Exposure to respirable dust during core cutting:

- Ensure workers wear appropriate respirators during core cutting tasks.

Noise disturbance due to core cutting operations:

- Consider noise-dampening measures for core cutting machinery.

General exposure to dust particles:

- Implement regular cleaning and dust control measures.

Exposure to respirable dust without silica:

- Continue using general dust control measures.

Re-assessment and Determination of Residual Risk:
After implementing the improvement requirements, re-assess the risk levels for each hazard considering the effectiveness of the control measures.
Residual Risk and Hazard Ranking:

Hazard	Residual Risk	Hazard Ranking
Prolonged exposure to high noise levels	Low	1 (Lowest)
Exposure to respirable dust with crystalline silica	Low	2
High noise levels during core cutting operations	Low	3
Exposure to general respirable dust	Medium	4
Noise disruption to workers at adjacent locations	Medium	5
Exposure to respirable dust during core cutting	Medium	6
Noise disturbance due to core cutting operations	Medium	7
General exposure to dust particles	Low	8
Exposure to respirable dust without silica	Low	9

7. Root-Cause Analysis

The Bow Tie method is used for risk assessment to identify potential causes (threats) and consequences of a

Hazard	Causes/Threats	Preventive Control Measures		Top Event	Preventive Recovery Measures		Consequences
		Current control Measures	Proposed Control Measures		Proposed Recovery Measures	Current Recovery Measures	
Prolonged exposure to high noise levels	- High noise levels from core cutting machinery and equipment.	- Installation of noise barriers and soundproofing materials. - Use of earmuffs or earplugs by workers. - Regular maintenance and calibration of equipment.	- Implement job rotation to reduce individual exposure time. - Optimize scheduling to minimize noise impact on adjacent workers.	Prolonged exposure to high noise levels	- Regular noise monitoring and workplace inspections. - Timely maintenance and calibration of noise-generating equipment.	- Regular noise monitoring and workplace inspections.	- Noise-induced hearing loss. - Decreased concentration and productivity. - Fatigue and stress. - Reduced ability to communicate effectively. - Potential for accidents due to reduced situational awareness.
Exposure to respirable dust with crystalline silica	- Generation of dust during core cutting operations.	- Water-based control system to suppress dust during cutting. - Use of local exhaust ventilation to capture and remove dust at the source. - Workers wearing fitted respirators	- Enhance the water-based control system. - Implement local exhaust ventilation with improved efficiency. - Conduct regular fit testing and provide refresher training on respirator usage.	Exposure to respirable dust with crystalline silica	- Regular monitoring of dust levels and workplace inspections. - Maintenance and calibration of control equipment. - Respirator fit testing and training on respiratory protection.	- Regular monitoring of dust levels and workplace inspections.	- Respiratory issues (e.g., silicosis) due to prolonged exposure. - Potential for lung diseases and long-term health implications.

Specific hazard which is given in below table.

		with proper training.					
High noise levels during core cutting operations	- Core cutting machinery and equipment producing high noise levels.	- Regular maintenance and soundproofing of machinery. - Use of earmuffs or earplugs by workers. - Installation of noise barriers.	- Continue with current preventive control measures. - Conduct regular equipment maintenance and optimize soundproofing.	High noise levels during core cutting operations	- Regular noise monitoring and workplace inspections. - Timely maintenance and calibration of equipment.	- Regular noise monitoring and workplace inspections.	- Temporary or permanent hearing damage. - Reduced communication and understanding of verbal instructions.
Exposure to general respirable dust	- Dust generated from various activities in the core cutting area.	- Use of general ventilation systems to reduce dust concentration. - Workers wearing dust masks. - Regular cleaning and dust control measures.	- Implement local exhaust ventilation near dust sources. - Provide more efficient respiratory protection. - Improve dust control measures.	Exposure to general respirable dust	- Regular monitoring of dust levels and workplace inspections. - Maintenance and calibration of dust control equipment.	- Regular monitoring of dust levels and workplace inspections.	- Irritation to respiratory system. - Potential for respiratory illnesses and reduced lung function.
Noise disruption to workers at adjacent locations	- Noise transmission to adjacent work areas from core cutting.	- Communication of core cutting schedules to adjacent work areas. - Use of temporary barriers to reduce noise transmission.	- Continue with current preventive control measures. - Explore additional measures to minimize noise propagation.	Noise disruption to workers at adjacent locations	- Regular communication with adjacent work areas. - Timely installation of temporary barriers.	- Regular communication with adjacent work areas.	- Disturbance in workflow and productivity of adjacent workers.

Exposure to respirable dust during core cutting	- Dust generated during core cutting operations.	- Use of local exhaust ventilation during core cutting. - Workers wearing dust masks.	- Enhance the local exhaust ventilation system. - Provide more efficient respiratory protection.	Exposure to respirable dust during core cutting	- Regular monitoring of dust levels and workplace inspections. - Maintenance and calibration of control equipment.	- Regular monitoring of dust levels and workplace inspections.	- Respiratory irritation and potential for respiratory illnesses.
Noise disturbance due to core cutting operations	- Noise transmission from core cutting to surrounding areas.	- Use of noise-dampening measures for core cutting machinery.	- Continue with current preventive control measures. - Explore additional noise-dampening techniques.	Noise disturbance due to core cutting operations	- Regular noise monitoring and workplace inspections. - Timely implementation of noise-dampening measures.	- Regular noise monitoring and workplace inspections.	- Disturbance to workers and nearby activities due to high noise levels.
General exposure to dust particles	- Dust present in the general environment of core cutting area.	- Regular cleaning and dust control measures. - Workers wearing dust masks.	- Implement additional local exhaust ventilation to reduce overall dust levels. - Provide more efficient respiratory protection.	General exposure to dust particles	- Regular monitoring of dust levels and workplace inspections. - Maintenance and calibration of control equipment.	- Regular monitoring of dust levels and workplace inspections.	- Potential for respiratory irritation and discomfort to workers.
Exposure to respirable dust without silica	- Dust generated from various activities in the core cutting area.	- Use of general ventilation systems to reduce dust concentration. - Workers wearing dust masks.	- Implement local exhaust ventilation near dust sources. - Provide more efficient respiratory protection. - Improve dust control measures.	Exposure to respirable dust without silica	- Regular monitoring of dust levels and workplace inspections. - Maintenance and calibration of dust control equipment.	- Regular monitoring of dust levels and workplace inspections.	- Irritation to respiratory system. - Potential for respiratory illnesses and reduced lung function.

TOP EVENT: Prolonged exposure to high noise levels in Core cutting shack

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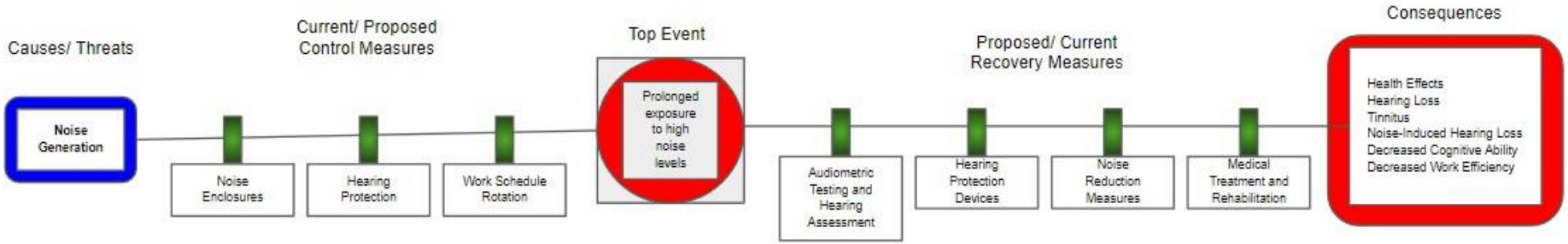

8. Recommendations

1. Noise Hazard:
    - Install noise enclosures with advanced hearing protection.
    - There will be periodic hearing assessments for workers exposed to noise.
2. Respirable Dust Hazard:
    - Improve water-based control and local exhaust ventilation.
    - Establishment of an entire program on respiratory protection.
3. Core cutting machinery is to be regularly maintained in order to reduce noise emissions and provide relevant hearing protection.
4. Control of dust during core cutting by use of local exhaust ventilation with improved respiratory protection.
5. Improve communication and the use of interim barriers to minimize noise disruption to nearby workers.
6. Enhance local exhaust ventilation and implement effective respiratory protection for dust suppression.
7. Continue noise reduction efforts for core cutting equipment.
8. Provide supplemental local exhaust ventilation and improved respiratory protection for incidental exposure to dust.
9. Utilize local exhaust ventilation and provide suitable respiratory protection for dust exposure where no silica is present.

9. Conclusion

In The overall conclusion of the project was to undertake a detailed evaluation of the hazards to health and safety arising from core cutting operations. Isolated serious risks included high noise levels and exposure to respirable dust with crystalline silica. Measures for prevention, proposed within, should diminish the risk from these factors by improving noise controls and respiratory protection.

It means that the implementation of the recommended measures may go a long way in significantly reducing incidents and consequences that could result from them, hence increasing the safety of workers within the organization. In this case, there will have to be regular monitoring and further improvements so that these controls remain effective and a safety and well-being culture at work is upheld. Commitment to health and safety protects not only the workforce but also enhances operational efficiency and sustainability.