

A CASE STUDY ON WORKPLACE EXPOSURE MONITORING FOR NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM) IN AN OIL & GAS INDUSTRY, STATE OF KUWAIT

OIL & GAS INDUSTRY, STATE OF KUWAIT

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KUWAIT OIL COMPANY (KOC)'S OPERATIONS

- Kuwait Oil Company (KOC) is one of the major oil and gas exploration companies in Kuwait / GCC .
- KOC's operational areas spread all over Kuwait and the operational areas covers 1,000 sq.km.
- 3 producing major assets in North Kuwait, South & East Kuwait and West Kuwait.
- Operations includes drilling, oil & gas production, export and marine.
- 25 Gathering Centers, 7 Booster Stations, 6 Water Centers, 25 Storage Tanks and Other different facilities.
- About 9000+ KOC employees & 80,000 Contractor employees.
- Diversified multinational workforce & Severe Weather Conditions.



Major facilities are:



2040 STRATEGY

Mission:

- We optimize the value of Kuwait's hydrocarbon resources by operating commercially and globally in an integrated and sustainable manner, while providing opportunities for our people to grow and contributing to Kuwait's economic development.

Vision:

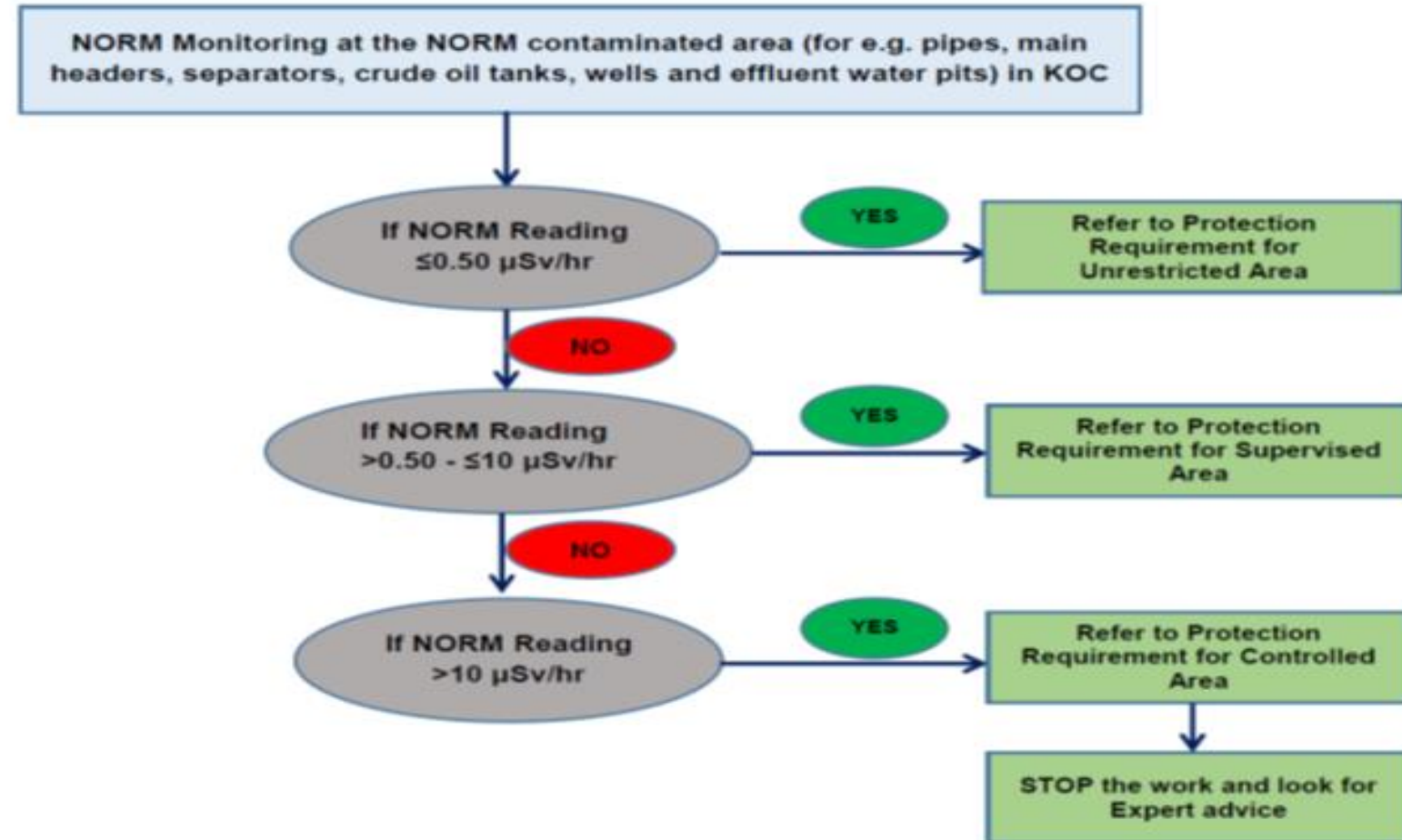
Our vision is to be a global, integrated oil & gas leader, through:

- Leveraging innovation to maximize profit
- Excelling with capable, motivated people
- Acting as a secure and reliable supplier
- Delivering efficiently and effectively
- Ensuring health and safety
- Respecting the environment

NORM Management Guidelines and Procedures

- NORM Monitoring and NORM Measuring Instruments
- Various NORM Surveys
- Classification of the Area
- Requirement for the NORM Contaminated Tools / Equipment
- Managing NORM Contaminated Waste
- Transportation Requirements
- Personal Monitoring Program
- Employee Awareness Training Program
- Radiation Safety Technician (RST) / Radiation Safety Officer (RSO) Requirements
- Signage & Labelling Requirements
- Medical Monitoring Requirements
- PPE and Other Safety & Health Requirement
- Types of Project complies with the company's HSEMS procedure.
- Organizations for the assistance of NORM survey
- Recordkeeping Requirements

Classification of the Area



Requirement for the NORM Classified Area

Derived Working Limits (DWL)	NORM Classified Areas	Requirements
Less than or equal to 0.5 µSv/hr	Unrestricted Area	<ul style="list-style-type: none"> ➢ Normal Work Permits ➢ Basic Approved PPE ➢ Good Personal Hygiene
Between 0.5 µSv/hr to 10 µSv/hr	NORM Supervised Area	<ul style="list-style-type: none"> ➢ Adequate training to the workers ➢ Radiation Permit To Work (PTW) required ➢ Work to be supervised ➢ Monitoring for the NORM to be conducted by the Radiation Safety Officer at frequent intervals during the work ➢ Use applicable PPE for NORM ➢ Control access to the public / office workers ➢ Demarcation with radiation warning sign
More than 10 µSv/hr	NORM Controlled Area	<ul style="list-style-type: none"> ➢ If the radiation level is more than 10 µSv/hr, STOP the work and leave the place. ➢ Demarcation with radiation warning sign ➢ Restrict worker access ➢ Seek for expert advice in the company

Qualitative Risk Assessment (QRA)

Occupational Health Risk is determined based on Severity (S) and Likelihood (L) of Occupational Health Hazards and will be ranked as 'low', 'medium' or 'high'.

Severity of Health Risk	Criteria
Negligible	Exposure to occupational health hazards resulting in negligible illness or health effects to people. On-site Medical Treatment Only Case (MTOC).
Minor	Exposure to occupational health hazards resulting in minor illness not affecting work performance. Restricted Workday Case (RWC) due to illness but not a Lost Workday Case (LWC).
Moderate	Exposure to occupational health hazards resulting in illness, affecting work performance and / or Lost Workday Case (LWC).
Major	Exposure to occupational health hazards over the exposure limits resulting in major illness or irreversible impact on health - Single fatality or permanent disability.
Severe	Exposure to occupational health hazards over the exposure limits resulting in major illness or irreversible impact on health - multiple fatalities or permanent disabilities.

Likelihood	Criteria
Very Unlikely	Not occurred in the Company or occurred once in more than 10 years
Unlikely	Occurred once in more than 5 years but within 10 years
Possible	Occurred once in more than 1 year but within 5 years
Likely	Occurred at least once in a year
Frequently	Occurred many times in a year

Occupational Health Risk Evaluation Matrix

		Severity				
		Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)
Likelihood of Occurrence	Very Unlikely (A)	Low (A1)	Low (A2)	Low (A3)	Low (A4)	Medium (A5)
	Unlikely (B)	Low (B1)	Low (B2)	Medium (B3)	Medium (B4)	Medium (B5)
	Possible (C)	Low (C1)	Medium (C2)	Medium (C3)	Medium (C4)	High (C5)
	Likely (D)	Low (D1)	Medium (D2)	Medium (D3)	High (D4)	High (D5)
	Frequently (E)	Medium (E1)	Medium (E2)	High (E3)	High (E4)	High (E5)

Risk Category	Risk Control Regime
High	The activity shall not be carried out as the risk is high. Adequate control measures shall be established to bring the risk level to at least "Medium". However, if the Company has to do the activity and determines to tolerate the risk, the activity shall not be carried out unless the risk is demonstrated to be as low as reasonable practicable (ALARP) with all the possible control measures within the influence of the Company. Approval from line management shall be obtained and all control measures must be in place and implemented before the activity can commence.
Medium	The risk is Medium. However, the activity shall be further assessed to determine if any additional control measures are required or possible to demonstrate the risk is reduced to "Low" or as low as reasonably practicable (ALARP). If required, such additional control measures shall be established before the activity can be performed.
Low	The risk is Low. No additional control measures will be required. However, the existing control measures shall be continued to be monitored to ensure the risk is maintained "Low".

Methodology and Instrumentation

Type of measurement	Purpose	Instrument	Total number of measurement or samples
In-situ External Radiation Dose Measurement	Measures external alpha, beta & gamma radiation levels.	Tracerco NORM Monitor (IS-T407)	39,199 Measurements
Personnel Exposure monitoring	Measures accumulated personal external radiation measurement.	Optically Stimulated Luminescent dosimeter (OSLD)	250 Personal samples



Results-Summary of NORM Contaminated Equipment (Based on External Radiation Measurement)

Potentially NORM contaminated equipment in different facilities.

Area	Facility	No. of Equipment	Type of Equipment NORM Contaminated	Area Classification
West Kuwait	Gathering Centre (GC)	3	Vessel / Flow Lines / Tubular / Heat Exchanger	[Supervised - <0.5 µSv/hr - 10 µSv/hr]
North Kuwait	Gathering Centre	3		
	Gathering Centre	3		
	Early Production Facility (EPF)	2		
Scrap Yard	Scrap Yard	4		

Potentially NORM contaminated soil surface locations in different facilities.

Area	Facility	No. of Equipment	Location (Common)	Area Classification
South & East Kuwait	GC	1	On Soil Surface below the base or manhole or drain outlet of the vessel / HP Wet Separator / MP Wet Separator / Dry Separator	[Supervised - <0.5 µSv/hr - 10 µSv/hr]
	Booster Station (BS)	1		
North Kuwait	GC	3		
	EPF	2		

Conclusions

- Workplace exposure monitoring for NORM indicated the following:
 - No areas are exceeding 10 µSv/hr in the entire operational facilities of the company.
 - Accumulated dose of the radiation workers were well below the permitted annual radiation dose.
- Flow and downhole pipes are potentially contaminated more than the other equipment in the operational facilities.
- Estimated NORM exposures is used as a baseline for assessing future impacts.
- NORM exposure is easily controllable in the operational facilities of the company.
- Exposure evaluation in the company aided for developing OH database on NORM for future use in local regulations in the Country.

Recommendations

- ✓ Removal and safe transportation of contaminated equipment/soil in compliance with the radiation safety program and local regulations in the State of Kuwait.
- ✓ NORM contaminated materials including vessels, separators, tubulars and others must be decontaminated.
- ✓ On-site decontamination must be carried out when equipment such as production separator vessel which cannot be reasonably removed.
- ✓ Removal of NORM scale inside these equipment shall be carried out by internationally recognized method (i.e. high pressure water jetting).
- ✓ Routine NORM monitoring that includes baseline surveys, pre-shutdown surveys and operational assessments.
- ✓ Specific monitoring during shutdown of vessels / tanks to insure that appropriate preparation for handling NORM is made for maintenance and workovers.
- ✓ Site workers (permanent employees and contractors) working around the NORM contaminated areas shall be monitored for personal radiation exposure using personal electronic radiation dosimeter or equivalent.
- ✓ Display radiation hazard signage at access point.
- ✓ Equipment (dose-rate and contamination meter) are available on-site for monitoring of workplace and workers.
- ✓ Implementation and follow-up on the required PPE in the operational facilities in the company.
- ✓ Routine awareness and specific NORM training to the workforce in the company.