

# **Personal Dosimetry to Radiation Workers**

## **Upgrading Old Petroleum Oil Field**

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# HSE and HSSE

HSE groups in petroleum industries control several types of hazards, physical and chemical hazards, ionizing and non ionizing radiations such as Sealed Sources , NORM.

In several companies security measures is added to HSE duties, Hence HSSE

# Sealed sources



# IAEA

- IAEA showed interest through its safety report entitled RADIATION PROTECTION AND THE MANAGEMENT OF RADIOACTIVE WASTE IN THE OIL AND GAS INDUSTRY (2003) and other NORM publications.

# NORM

From our experience

Regionally NORM and TENORM activates were carried in North Africa and Middle East since mid 90's .

# Atomic Energy Authorities

The Atomic Energy Authorities of several middle East Countries showed interest in regulating NORM activities such as

Syria (Syrian Radiation protection regulations 2007) and

Egypt (Egyptian NORM regulations 2006)

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# Some Local published works

Saudi Arabia NORM studies were reported by Nassar et al (2008) at ARMCO oilfields at IRPA-12.

Othman et al (2008) reported Syrian NORM experience at IRPA-12.

Alsumiri et al (2007) reported NORM activities at Yemen

# Research and development

Among Egyptian NORM activities the followings  
Research and development studies in the field  
of treatment of NORM Waste using local  
materials, Aly (2009).



# Contaminated Metallic equipment

In Egypt , Atomic Energy Authority regulate and control NORM contaminated metallic equipment resulted from Egyptian oil industries.

EAEA issue certificate of clearance of uncontaminated units

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# AFRA project

Participating in AFRA projects dealing with NORM Radiation protection consultations and service at various Egyptian oil Producing companies

# Egypt- NORM Regulations

In 1962, ( Executive regulation of Egyptian IR Law) materials emitting ionizing radiation are exempted from regulatory control if activity concentration less than 2 nCi/g.

Egyptian NORM regulations were issued as Atomic Energy Authority orders for site categorizations as PET(1) It was issued at 1999 and it was updated as PET(2)in 2006.

# EAEA order 166(2006)

## classification of working conditions

1- Category-A

Dose rate  $>7.5 \mu\text{Sv/h}$  and  $>1\text{Bq/gRa-226}$

2- Category-B

Dose rate  $0.5$  to  $7.5 \mu\text{Sv/hg}$  and  $> 1 \text{ Bq/g Ra-226}$

3-Category-C

Dose rate  $>0.5 \mu\text{Sv/h}$  and  $>1\text{Bq/g Ra-226}$

4- Category-D

Dose rate  $>0.5 \mu\text{Sv/h}$  and  $>1 \text{ Bq/g Ra-226}$

# Radiation Protection Requirements

- For Category A
- Supervised by a radiation protection expert
- Assignment of controlled areas
- Detailed radiation survey 4 times every year (at least)
- Determination of specific activity of Ra-226 in solid and liquid waste
- Radiation measuring instruments

# RPR-1

Cleaning of equipment or remediation of •  
lands from radioactive contamination should  
be done by licensed companies

Training on radiation protection , the national  
course

Norm waste management program for  
temporary storage and final disposal

Record keeping system

# NORM Waste

- Liquid / temporary storage can be done into a designated lined ponds . No discharge into the soil
- Solid / re-injectd in abandoned wells ....

Tempary storage can be done in durable containers or lined compartments in a designated area

# Contaminated equipment

- Decontamination to less than 0.4 Bq/cm<sup>2</sup> for alpha emitters and 4 Bq/cm<sup>2</sup> for beta and gamma emitters
- Contaminated equipment can be stored temporarily in a designated store yard after....



# Clearance of metallic equipment

External Gamma ray dose rate  
less than 0.5  $\mu\text{Sv/h}$

# Other Egyptian regulations

Following Environmental Law (1994)

2- Hazardous Radioactive waste

Electricity and Energy Ministerial order (2004)

Updated in 2008

# Other Egyptian regulations

Following BSS •

EAEA issued its order no 83(2005)

# Other Egyptian regulations

Hazardous Radioactive waste

Electricity and Energy Ministerial order (2004)

Updated in 2008

# **Radiation Monitoring at oilfields**

The scope of the Radiation protection consultations and services cover several oil and gas companies in Egypt. These companies and its oilfields are located at the Sues Gulf and at Western Desert.

# Working Area Classification

Normal area  $< 0.5\mu\text{Sv/h}$ ,

Supervised area  $0.5 < \text{DR} < 3 \mu\text{Sv/h}$ ,

Controlled area  $3 < \text{DR} < 10 \mu\text{Sv/h}$ , and

Restricted area  $\text{DR} > 10 \mu\text{Sv/h}$

Where DR is the exposure rate

# Gamma ray Monitoring

By Periodic Gamma ray Monitoring at various sites (even around pipes entering process plant) one can differentiate between oilfields free from NORM and NORM oilfields.

# Upgrading

When production rate is decreased , water injection is applied . In some oilfields LSA scale is produced. In order to upgrade old oilfield , several contaminated units are replaced by new units.



# Personnel Dosimetry

For Personnel Dosimeters , such as Film badge •  
(FB), Thermo luminescence dosimeters (TLD)  
are in use for estimation of external exposure  
and for internal Dosimetry ,whole body  
counter is used.

# Safety at Work - medical

All workers are medically examined including  
CBC -pre-employment  
Period examination

# Dosimetric Results

Personnel dosimetry were carried out through contracting with several Egyptian services petroleum companies involved in cleaning NORM contaminated units.

In the present study external gamma ray doses were registered for two cases only these are:-

Case one, for workers completed their work within 2 months (early phase) and

Case two, for workers carried out their work for several periods up to 6 months.

## **3.1.Case -1 Workers completed their work within two months**

Table-1-1 Dose Distribution for contracting workers

Table-1-1 Dose Distribution for contracting workers

Dose range in mSv	No of workers	percentage
0-0.5	148	77%
0.5-1.0	24	12%
1.0-1.5	11	06%
1.5-2.0	03	02%
2.5-3.0	05	03%

Table 1-2 –Variation of dose range and average dose for workers from various contracting companies

Contractor No	No of workers	Min mSv	Max mSv	Total mSv	Average mSv	
1	82	0.1	1.7	24.8	0.3	
2	24	0.2	2.2	07.2	0.3	
3	20	0.1	2.1	09.0	0.45	
4	16	0.1	2.3	07.2	0.45	
5	15	0.1	0.3	03.0	0.2	
6	15	0.1	1.1	05.7	0.38	
7	6	0.1	0.6	01.6	0.27	
8	4	0.1	0.3	0.9	0.225	
9	3	0.1	0.2	0.6	0.2	
10	2	0.05	0.1	0.2	0.1	
11	2	0.3	1.1	1.4	0.7	
12	1	-	-	0.3	0.3	
13	1	-	-	0.2	0.2	
14	1	-	-	0.4	0.2	
Total	192	0	2.3	65.9	0.35	

Table-2-1 Gamma ray dose range and average dose for group of workers completed up to seven working periods

Period no.	No of workers	Average dose in mSv	Range in mSv
1 <sup>st</sup>	29	0.15	0.05-1.0
2	34	0.14	0.05-1.0
3	26	0.15	0.05-1.4
4	37	0.15	0.05-0.7
5	30	0.05	0.05-0.3
6	30	0.23	0.05-0.9
7	06	0.22	0.05-0.5



**3.2 Case-2 For groups of workers from different contracting companies , completed several periods**

Table-2-2 a Gamma ray Dose distribution for workers , period of 5 months

Dose range	Number of workers	percentage
0 to 0.5 mSv	463	59.36%
0.5 to 1.0 mSv	155	19.87%
1.0 to 1.5 mSv	100	12.82%
1.5 to 2.0 mSv	38	04.87%
2.0 to 2.5 mSv	15	01.92%
2.5 to 3.0 mSv	09	01.15%
	780	

Table-2-2 b Gamma ray Dose distribution for workers , period of 5 months

Dose range	No of workers	percentage
Less than 1 mSv	618	79.24%
Greater than 1 mSv	162	20.76%
Collective dose	0.482 person Sv	
Average dose	0.62 mSv	

Table2-3 Summary of workers external gamma ray doses  
1 to 6 months

Period in days	No of workers man	Collective dose Man. Sv	Average dose mSv
32	236	0.118	0.5
113	748	0.271	0.37
124	767	0.382	0.49
154	780	0.482	0.62
179	909	0.556	0.61

# Conclusions

From the present work results , The average external gamma ray dose received by worker was 0.6 mSv .Furthermore it is clear that 80% of the workers from contracting companies received gamma ray doses less than 1 mSv while 20% of the workers received doses greater than one mSv during their work. Few workers received doses up to 4 mSv.

# References

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