



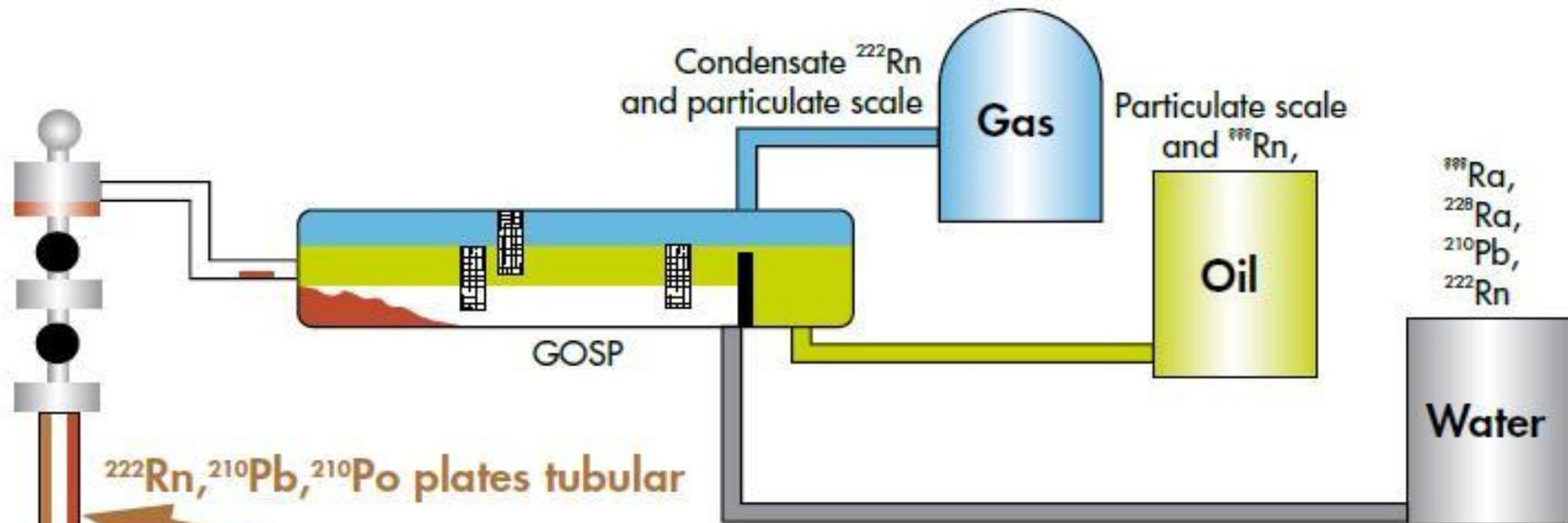
أرامكو السعودية
Saudi Aramco

A Case Study

Development of NORM Management Strategy for Oil & Gas Industry



NORM is an unwanted by-product of oil & gas production



^{222}Rn , ^{210}Pb , ^{210}Po plates tubular

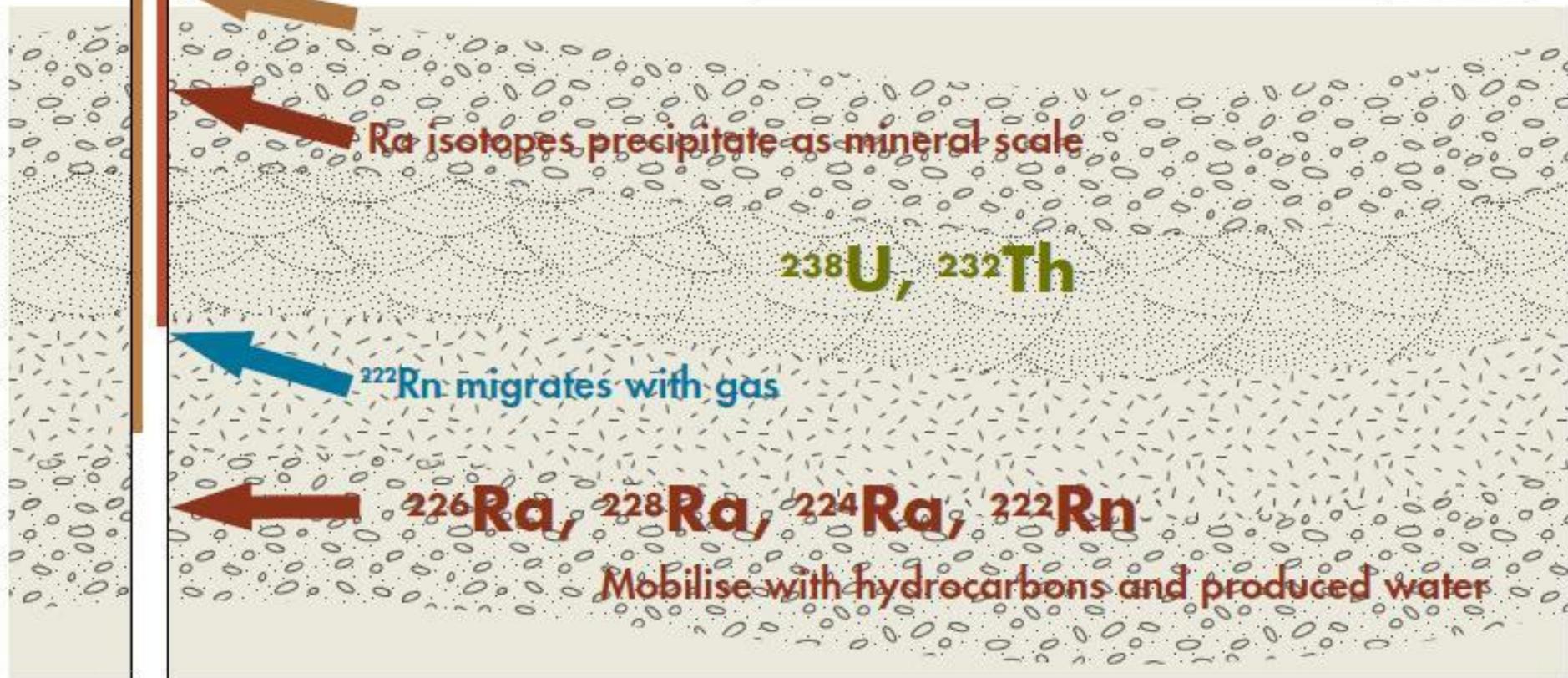
Ra isotopes precipitate as mineral scale

^{238}U , ^{232}Th

^{222}Rn migrates with gas

^{226}Ra , ^{228}Ra , ^{224}Ra , ^{222}Rn

Mobilise with hydrocarbons and produced water



We could detect NORM

So we could manage NORM



In the beginning.....



All efforts focused on monitoring



No storage facilities for waste & equipment



No NORM decontamination available



No available disposal route for NORM



No NORM Standard/Procedure

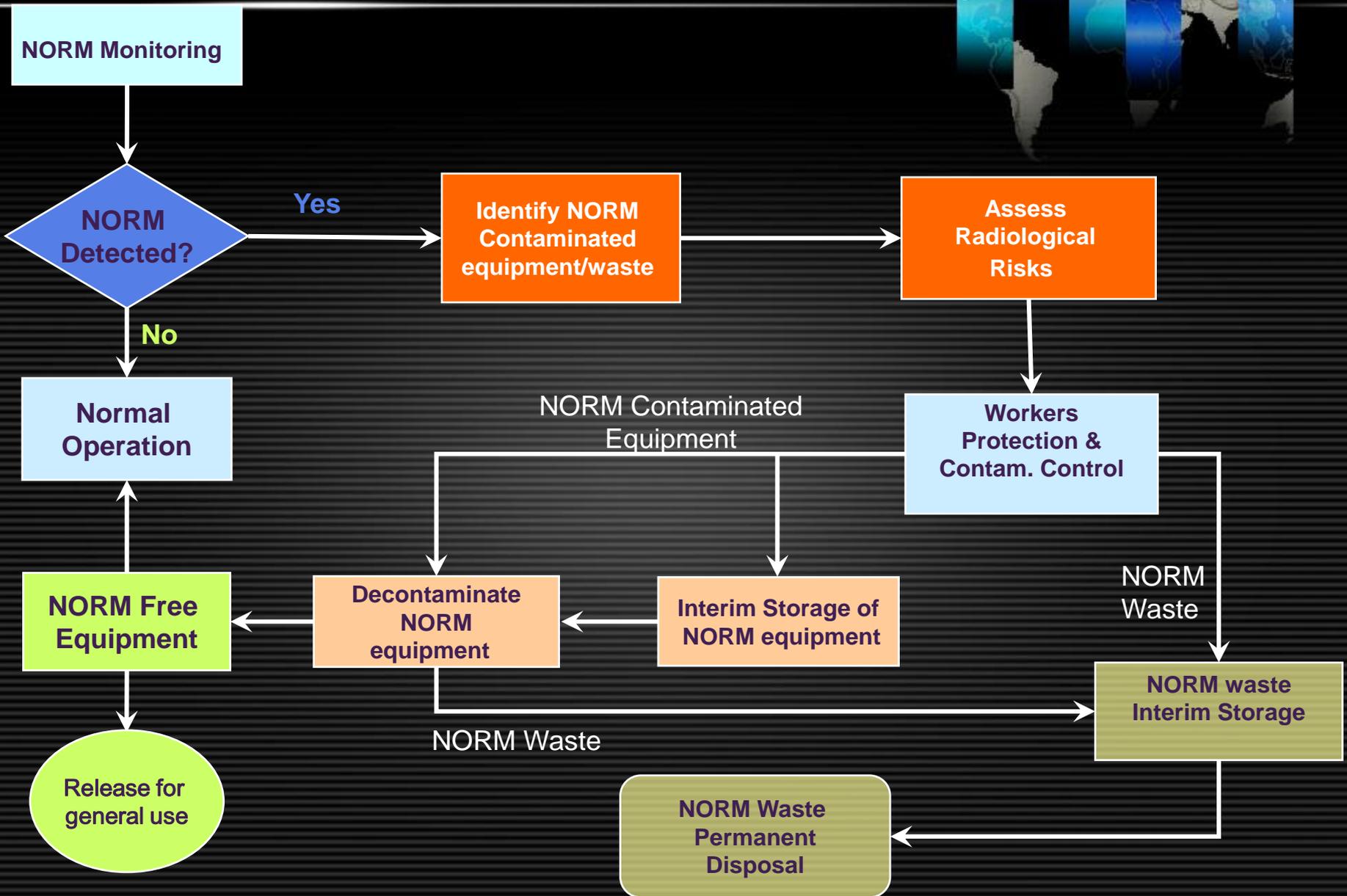
Our reaction was



- Review Applicable Standards & Guidance
 - Not user friendly
 - Did not provide guidance
 - Inconsistencies
 - Not readily helpful



We developed a process cycle



Action Level



Standard

We required to detail the core components to enable management of NORM

Identification

Equipment
Control

A strategy was required to deliver the process cycle objectives

Waste Control

Workers
Protection

Training

- Prioritize Tasks
- Manage Resources
- Develop Guidance

Action Level

Indication of double background level =
NORM contaminated

Isotope Specific Exemption Levels

Radionuclide	Exemption Level (Bq/g)	Exemption Level (pCi/g)
Ra-226	1.1	30
Ra-228	1.1	30
Pb-210	0.2	5
Po-210	0.2	5
U-238	5.5	150
Uranium (Nat)	3.0	80



Corporate NORM Standard



Engineering Procedure

SAEP-358

8 December 2010

Management of Technologically Enhanced
Naturally Occurring Radioactive Material (NORM)

Document Responsibility: Environmental Standards Committee

Saudi Aramco DeskTop Standards

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Previous Issue: 30 March 2005 Next Planned Update: 8 December 2015

Primary contact: [Mouzly, Khalid Ahmed](#) on 966-3- 8760351

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- Responsibilities
- NORM Surveys
- Storage of Waste
- Disposal of Waste
- NORM contaminated equipment
- Workers Protection
- Contamination Control
- Confined Space Entry
- Transportation
- Decontamination
- NORM Contamination Limits
- Contingency Plans



NORM Management Strategy

**NORM
Monitoring**

**Control of
Contaminated
Equipment**

**Control of
NORM Waste**

**Workers
Protection &
Training**

**Enhancing
Performance**

Enabled SA to achieve workers, public, and environmental Protection without impacting operational productivity

NORM Monitoring

Control of Contaminated Equipment

Control of NORM Waste

Workers Protection & Training

Enhancing Performance

Baseline Surveys

Pre-T&I Surveys

Routine Assessments

Legacy Contamination Surveys

Offshore platforms

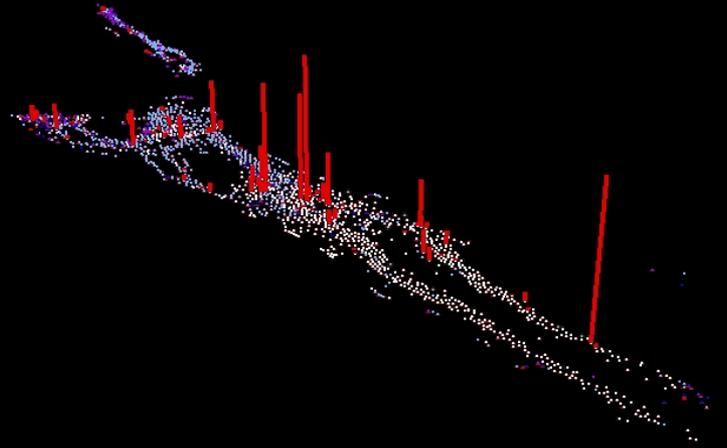
Onshore platforms

GOSPs

Gas Plants

Seawater Injection System

Pits



NORM Monitoring

Control of Contaminated Equipment

Control of NORM Waste

Workers Protection & Training

Enhancing Performance

Equipment Screening

Handling Contaminated Equipment

Decontamination



NORM Monitoring

Control of Contaminated Equipment

Control of NORM Waste

Workers Protection & Training

Enhancing Performance

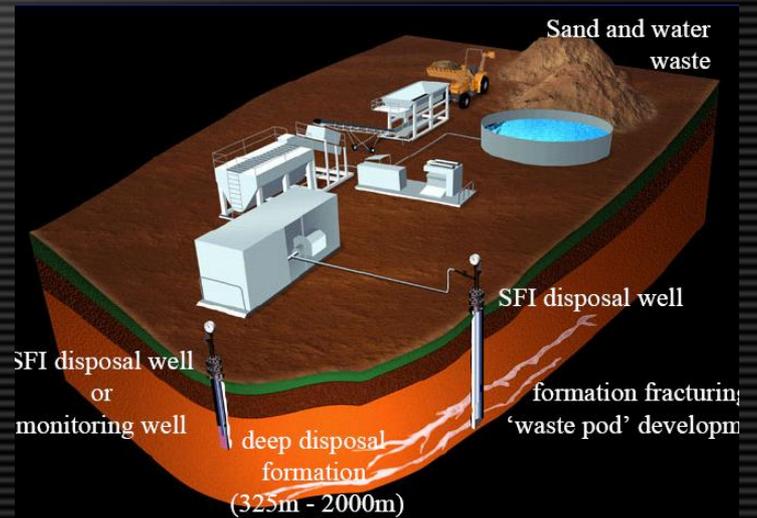
Norm Waste Storage

Norm Waste stored in controlled manner



Permanent Disposal

Detailed Risk Assessment



NORM Monitoring

Control of Contaminated Equipment

Control of NORM Waste

Workers Protection & Training

Enhancing Performance

Protect Workers

**Procedures
Personal Protective Equipment**

Enhance Awareness

**Presentations
Tool Box Talks**

NORM Training

**Formal Training
Established**



NORM Monitoring

Control of Contaminated Equipment

Control of NORM Waste

Workers Protection & Training

Enhancing Performance

Development of NORM Guidelines

Sharing Best Practice

Conference Participation

Workshop on NORM Management

RPA Program

EMS



Guidelines for the management of Naturally Occurring Radioactive Material (NORM) in the oil & gas industry

Report No. 412
September 2008

NORM Management in the Oil & Gas Industry

Michael Cowie, Khalid Mously, Osama Fageeha, Rafat Nassar

NORM Monitoring

NORM monitoring is composed of four main components namely:

- Baseline surveys
- The field and laboratory TBT surveys
- Operational assessments
- Large contamination surveys

The objective is to establish a baseline of the spread and level of NORM contamination in Saudi Arabia facilities. This information is essential to determining which category of workers need production guidelines, and type of contamination control practices. Baseline surveys only yield information about NORM waste that is already in the environment which is essential to plan remedial and decontamination activities.

The TBT surveys

The objective is to determine the location of NORM accumulation in facilities where NORM contamination is reported, such as the Uthmaniyah Separation Plant (USP), 24 weeks before each TBT. If NORM presence is detected, proper procedures are implemented to prevent workers, activities, equipment contamination during the oil control.

Operational assessments (OA)

The objective is to identify whether there is NORM contamination. The objective is to identify whether there is NORM contamination. The objective is to identify whether there is NORM contamination. The objective is to identify whether there is NORM contamination.

Control of NORM Contaminated Equipment

Control of NORM contaminated equipment is composed of three stages namely:

- Inventory of Equipment
- Cleaning of Equipment
- Decommissioning of NORM Contaminated Equipment

The objective is to establish and implement practical and effective procedures to identify and categorize NORM contaminated equipment using practical, established and finally radiation detection devices. EPA provides the necessary training to conduct the NORM cleaning or testing methods measured by competent contractors approved by FPS.

Workers Protection and Training

Workers Protection

In line with Saudi Aramco policy, the highest priority in the NORM strategy is to protect workers through:

- Shield decontamination of workers as protective
- guidelines when it holds surveys are not yet conducted by adopting the conservative approach if NORM contamination is suspected.

Training

The objective is to train selected employees in facilities with potential NORM contamination to perform operational NORM assessments and TBT surveys.

Four training courses have been developed by FPS and are coordinated by Professional Engineering Development Division. The courses are:

- NORM Naturally Occurring Radioactive Material Workers Course
- NORM Naturally Occurring Radioactive Material Supervisors Course
- NORM Naturally Occurring Radioactive Material Supervisors Course
- NORM Naturally Occurring Radioactive Material Radiation Safety Officers Course

Workshop on NORM Management in Oil & Gas Facilities

Sharing Best Practices in Petroleum Industry

May 22-24, 2006
Dhahran, Saudi Arabia

Dear Colleagues,

On behalf of the organizing committee, it gives me a great pleasure to invite you to attend the **Workshop on NORM Management in Oil & Gas Facilities: Sharing Best Practices in Petroleum Industry**, which will be hosted by Saudi Aramco in Dhahran, Saudi Arabia, during the period of May 20-21, 2006. The workshop will include technical presentations and panel discussions.

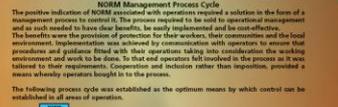
For registration and more information, please visit the workshop website at http://www.co2management.org/norm_workshop.php

EARLY REGISTRATION IS HIGHLY ENCOURAGED

Looking forward to meeting you in Dhahran, Saudi Arabia.

A.F. Al-Wahab
Chairman NOCs Environmental Working Committee
Saudi Aramco

NORM MANAGEMENT STRATEGY



Summary



NORM is a global issue for oil & gas industry



Analyze process to identify NORM impacts



NORM Management Strategy aids planning



Prioritize tasks to enable control and optimize available resource



NORM can be managed in the absence of International & National Regulation



Thank You