

PUBLIC AND REGULATORY ACCEPTABILITY OF NORM CONTAMINATED SOIL DISPOSAL: THE SYRIAN EXPERINCE

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ABSTRACT

This paper describes the Syrian experience in respect to the public and regulatory acceptability of the disposal of NORM contaminated soil generated by the Syrian oil industry. This was dealt with good cooperation between the oil companies and the Atomic Energy Commission of Syria (AECS). A policy was established to solve the problem with an effective, fast and cooperative method. The presence of NORM contamination was first explained to the public in the area, where lectures were given, by specialists, to educated inhabitants live in the area; more than 1000 doctors, school lectures, farmers, politicians and other government officials of the area have attended the lectures and their comments being evaluated. All workers in oil companies including services companies were given NORM awareness courses. In addition, two international workshops were also organized; personnel from the regulatory, scientific centers and oil companies were gathered to exchange experience. Publications in both languages, Arabic and English were prepared as lecture notes about NORM and distributed to enhance knowledge of the public and workers. On the other hand, risk assessment studies and other technical measurements by specialists have also been carried out to establish the disposal criteria of NORM contaminated soil by a special advisory committee to the regulatory office. Final certification of the remediated sites and future monitoring of the disposal pits were the main ways for regulatory acceptability.

INTRODUCTION

Water co-produced with the production of oil and gas contain enhanced Naturally Occurring Radioactive Materials (NORM) resulting from the ^{232}Th and ^{238}U -series. The presence of NORM in oil and gas streams has been recognized since the early 1930s (1, 2, 3, 4, 5). This water, which contains mainly radium isotopes, is currently considered to be the largest generated volume of radioactive waste by the oil industry. This water is now separated from oil and disposed of by some means such as down an injection well and disposal well (5, 9,14). Uncontrolled disposal of this type of waste could lead to environmental pollution and thus to radiation exposure of members of the public (5, 6, 7, 8, 10, 11, 12). Many oil companies in the World have used to discharge production water into the environment in unlined artificial lagoons and pits for evaporation. These pits become with time highly contaminated with NORM where leaching processes and transfer of radioactivity to underground water may occur. This radioactive contamination should urge the oil companies to initiate remediation programs with the help of specialists in the field of radiation protection, engineering, designs and waste management. Detailed site survey and material characterization usually performed to assess the volume, magnitude, type of waste materials and hence the approved disposal option (12, 15, 17, 18, 19). However, the initiation of any remediation program requires not only these technical data but public and regulatory acceptability are also important.

DESCRIPTION OF THE SITUATION

Syrian oil wells are located approximately 700 km to the northeast of Damascus and near to the City of Der Ezzor. Oil and gas together with production water are routed to various Central-Processing Facilities (CPF) for separation and processing. In the past, unlined evaporation pits have been used to hold water, which have been lost by evaporation. Some run-off channels had been created to allow water to run-off into the desert. Most of the pits were contained with bound walls. Most lagoons have a number of sinkholes in their bases from which rapid drainage has been observed into the sub-surface. In addition, the Syrian oilfields are situated near several villages and Bedouin camps in the area where their sheep being grazed and watered in the areas. Moreover, some farmers use ground water (5-70m deep) or Euphrates River water for irrigation. This radioactive contamination problem has urged the Syrian oil companies to initiate a remediation program in cooperation with the Atomic Energy Commission of Syria to protect people and the environment. Furthermore, the Atomic Energy Commission of Syria has formed a force task group so called the "oil project group" in order to work a long with the oil companies to overcome the problem in a fast, effective and cooperative method. The group consisted of several specialists in NORM, geologist, radiation protection, radioactivity measurement and radioactive waste management. Many technical reports were produced in addition to holding day to day meetings among personnel from the group, oil companies and regulatory authorities. Experts from outside Syria were also invited to exchange experience. However, the Syrian remediation program which was planned and initiated by the Atomic Energy Commission of Syria in cooperation with oil companies consisted of four phases, viz. preliminary radiation survey, characterization of contaminated soil volume, preparation of a remediation plan, remediation work and the final survey for certification.

TECHNICAL STUDIES

Detailed site gamma survey and soil characterization was first performed to assess the volume and type of waste materials at all NORM contaminated sites. Gamma survey of the affected areas in all fields was carried out using portable monitors (counts per second). Radiation contour maps were then established for each site and different zones being defined using Surface Mapping System Software. In addition, selective core sampling in the hot spots and average contamination zones were defined and the volume of contaminated soil to be removed to the disposal site was determined by the exemption criteria applied (16, 19). Radon measurements in air, soil and water and radioactivity in groundwater were also conducted. However, the remediation plan based on the results of the preliminary gamma radiation survey and estimated volume of the contaminated soil has been prepared. This plan included results of the survey, brief description of the situation of the contaminated land, the proposed clean and disposal option, design of disposal site, procedure for the remediation work and monitoring programs of the site after remediation. However, the choice of the disposal option was based on a quantified risk assessment study conducted by Atomic Energy Authority Technology UK, (AEAT) (18).

PUBLIC ACCEPTABILITY

The issue of public acceptance is the main concern of the oil companies since it may affect the production and the process of radioactive waste management and disposal. While approval of regulatory authorities and environmental organizations can be easily obtained since all technical data and scientific information can be made available. However, the word radiation raises many concerns in the minds of the general public and may give fears to those ignorant people and to be a big problem. Therefore, it was decided first to approach the public relations and in the same times the oil workers who lives in Der Ezzor city and surrounding villages. It was agreed between the AECS and the operating companies to hold an evening in Der Ezzor City and invite the Der Ezzor communities. The General Director of the AECS and some members of the oil project group have met the local governor and other governmental authorities. They were provided with information about the planned project and the need for good cooperation from all parties in the area to initiate the remediation project.

Der Ezzor community members were invited to attend short lectures (two hours in total) in one of the biggest City Halls, only educated inhabitants being invited for these lectures. More than 1000 doctors, school lectures, farmers, politicians and other government officials of the area attended the evening. The first lecture was given by the Operation Manger of one of the largest operating oil companies. Information about the importance of the oil production in the area and the benefits gained by the City community were emphasized in addition to jobs and logistics services which were made available for the community. The Operation Manger gave life undertaken projects to protect members of Der Ezzor community, workers, environment where international standards being applied.

Since "Radiation" was likely to be the topic that would be of most concern, they were given accurate information about it. This was achieved by two lectures given by the General Director of the Atomic Energy Commission of Syria. Introduction about radiation and the role of the Atomic Energy Commission of Syria was first given with more detailed manner. Emphases on the control of radioactive sources by AECS were one of the main parts of the talk; regulations released by AECS can be made available for any Syrian. Radiation sources used in medicine either for diagnosis or radiotherapy and the dose associated with these uses were fully explained in addition to the applications of radioisotopes in other fields such as agriculture, science branches and industry including oil industry. Moreover, risks related to radiation were compared with other risks dominant in our lives such as car accidents, smoking, and others. All of these were presented to assure public acceptability to the fact that there many risks in our lives more important than the controlled risks associated with radioactivity. Protection measures against radiation which are easy to adopt are also mentioned.

The second lecture was dedicated to NORM in oil and gas industry. Information on natural background (natural levels of NORM), radionuclides, from uranium and thorium series, in food, air, water and rocks were presented in addition to radiation coming to earth from outside, viz. "cosmic rays". Generation of NORM by the oil and gas industry was fully explained where a comparison with the natural levels being tabulated. The global appearance of NORM in other countries and their experience was also shown by presenting data and figures. Wastes generated by the industry including contaminated soil, production water, sludge and scales were also defined to the attendees; methods for safe disposal which are

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internationally accepted, being shown. Risks due to the presence of NORM in oil production equipment and the environment to the workers and general public were compared with other risks. In addition, protection equipment and some procedures followed by the oil workers were shown.

Questions raised by the attendees were answered where accurate information being given. Advice by the General Director of the AECS that for further knowledge about the subject can be obtained from the AECS and any one can feel free to contact the Department of Protection and Safety for this purpose. However, comments from the attendees reached AECS and the oil companies after the evening were evaluated where public acceptability was very clear and all hidden fears being dismissed.

OIL COMPANIES: MANAGEMNET AND WORKERS

The problem of NORM in the Syrian oilfields was first discovered by the Department of Protection and Safety of AECS in 1987 (8). Actions and involvement for more investigations have been started in 1994 when the problem of land contamination has been shown up and more concern by safety officers in the oil companies being explained to AECS. Since the remediation work requires efforts and money, it was the role of the AECS and safety officers to justify any proposals to overcome this problem. This was dealt with by giving accurate information to management of all operating oil companies and workers. For oil companies' management, visits by The General Director of AECS and members of AECS oil group were made to assure good cooperation and quick problem solving. Lectures and training courses for mangers and supervisors were organized in Damascus and the field and information about NORM problem and the required procedures that should be followed by the oil companies being delivered. Notes in Arabic and English were distributed during any presentations in addition to a list of publications that show the experience of other countries.

For work supervisors, workers in the operating companies and services companies (well logging, drillings, casing, NDT and others), three levels of training courses were organized, viz. NORM awareness course for workers, NORM course for supervisors and radiation protection supervisors course. All courses contain the following topics:

- Radiation and Radioactivity
- Types and Properties of Radiation
- Background Radiation
- Naturally Occurring Radioactive Materials (NORM)
- NORM in Oil and Gas Industry
- Detection and Measurement of NORM
- Surveying and Sampling of NORM
- Radiation Protection Principles and Practices
- Health Risk of Radiation
- Workers Protection
- MORM Regulations
- NORM Removal
- Storage of NORM contaminated materials
- Disposal of NORM contaminated materials
- Transporting of NORM contaminated materials
- Remediation of contaminated lands

Therefore, all involved parties in the project were given the knowledge about NORM. In addition, two international workshops were organized by the AECS where safety officers and managers, regulatory personnel were invited. Experts in the field of NORM and risk assessment were invited to give talks in these workshops.

REGULATORY ACCEPTABILITY

The lack of specific Syrian regulations for NORM contaminated sites turned out to be a problem. However, there is only one regulatory authority in the country that deals with the radiation which is the Radiation and Nuclear Regulatory Office (RNRO). This has made the problem to be easily dealt with where quick and good results being achieved. Moreover, remediation project has been planned, initiated and completed in cooperation with the RNRO. Clean up criteria was set according to the risk assessment study carried out by specialists from AEAT,UK. (8). Therefore, the following Syrian criteria for disposal and clean up of contaminated soil has been defined (16):

1. Soil containing not more than 0.15 Bq/g of ^{226}Ra does not need any treatment.
2. Soil having specific activity of ^{226}Ra higher than 5.2 Bq/g need to be managed as radioactive waste.
3. Contaminated areas containing ^{226}Ra with concentration between 0.15 Bq/g and 5.2 Bq/g need a special treatment on site to reduce the exposure to a value below 100 $\mu\text{Sv/a}$.

Cost benefit analysis was the approach for the choice of clean up options of contaminated sites. It was proposed to construct disposal mounds for disposal of contaminated soil having activity higher than 5.2 Bq/g under strict regulatory control. The RNRO has approved the option provided that the following procedures and requirements being met:

1. Technical studies: The RNRO has been provided with all technical data and reports produced by the Department of Protection and Safety. In addition, the quantified risk assessment study results were explained to both regulatory and the oil companies where different options for disposal of contaminated soil being discussed.
2. A full detailed remediation work with all radiation protection measures being submitted to RNRO for approval.
3. Adoption of radiological controls to minimize all risks associated with the civil engineering works.
4. Strict procedures and continuous supervision from AECS to ensure protection and safety for the workers, public and the environment.
5. Implementation of environmental monitoring program was also requested by the RNRO for the disposal pits and the surrounding areas, viz. periodical check for the integrity of the pits, radon emanation monitoring and ground water monitoring.
6. The RNRO has sent from time to time some inspectors to control the license requirements.
7. Final survey was carried out after completion of the work; the area was verified according to the requirements of the license.

The remediation project at one of the largest operating oil company in Syria has been recently completed according to the above approach.

CONCLUSION

NORM contaminated areas in Syrian oil fields have been defined and remediation projects were planned, initiated and implemented. Public acceptability of the presence of NORM and treatment and disposal of contaminated waste was achieved by keeping good relations and contacts through meetings and informative lectures. Regulatory acceptance was achieved by good cooperation between the regulatory authority and the oil companies where technical data, scientific studies and implementing all license requirements being the role of the regulatory acceptance. However, the Syrian experience in this respect can be considered as an example for other neighboring countries posing similar problem.

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