TRAINING OF INDUSTRIAL RADIOGRAPHERS FOR RADIATION SAFETY

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ABSTRACT: Industrial Radiographers (IRs) working in Saudi Arabia are technicians with different scientific background and qualifications. The majority of them are from south East Asia (India, Philippine, Bangladesh). The remaining are from Saudi Arabia, Jordan, Egypt and other countries.

The background and qualifications of those IRs are different due to their origin differences. Saudi Aramco Criteria for the approval of all IRs to work on Saudi Aramco properties require them to pass a qualification exam called “Radiation Protection Permit Exam”. Similar qualification requirements for all radiation workers in the kingdom will start soon by the National Radiation Protection Authority-King Abdulaziz City of Science and Technology (KACST) in Riyadh.

The qualification of the IRs for radiation safety requires them to know the recommended concepts approved by the regulatory authority and Saudi Aramco.

Saudi Pioneers for Specialized Services (SPSS) is having two radiation training licenses: (1) for Radiation Safety officers (RSOs) and (2) for Radiation Workers (RWs). The two licenses issued from KACST. The SPSS training staff is highly qualified and has a long experience training RSOs and RWs since 1991. The KACST approved training manual covers the entire related subjects. The paper will highlight the training and qualification procedure and capabilities of SPSS for IRs training as per Saudi Aramco and KACST requirements.

INTRODUCTION:

At the time of Chernobyl Nuclear Reactor Accident in 1986, the SPSS expertise (the author) coordinated a national training course for 34 employees of the Ministries of (1) Health and (2) Trade who are checking the quality of the imported materials to the kingdom. The course was

practical and theoretical on the basic radiation protection and the measurements of radiation level in the imported food/materials to the kingdom using various portable and fixed radiation monitoring instruments/detectors. In addition the counting statistics of the nuclear instruments was included in the course. Also, SPSS expertise (the author) established, for the first time in Saudi Arabia, in 1991 a one-week training course on Principles of Radiation Protection in Saudi Arabia. The course provide the candidates with the basic and principles of radiation protection information needed as preparation to pass the Government exam held by the National Regulatory Authority (King Abdulaziz City of Science and Technology (KACST). The course was offered since then more than 50 times and was the only course available in the kingdom in English at that time. Hundreds of candidates managed to pass the RSO exam and become certified by KACST. They are now performing their duties on various facilities using radioactive sources.

In the last few years huge industrial projects initiated in the kingdom of Saudi Arabia. Most of those projects were in petrochemical sectors like in Saudi Aramco and Sabic. As a results of this advancement, the application of Radiation based technologies as quality control of the fulfilled jobs become an essential. An example of the useful application of the Radiation based technologies is the Industrial Radiography [1].

Industrial Radiography is an important Non-Destructive Testing (NDT) technique. It is used for the quality assurance of welds during facility and pipeline construction. It is also an important diagnostic tool throughout facility/pipeline operational lifetime used for inspection of welds, valves, and corrosion detection. The cost avoidance and benefits as a result of using this technique are incalculable.

In Industrial Radiography, highly penetrating ionizing radiation (gamma or x-ray) is used. The radiation is obtained from industrial x-ray machines, linear accelerators or selected radioactive materials such as $^{192}$Ir and $^{60}$Co. The radiation penetrates the inspected object and creates an image on a special film placed at the opposite side of the object. The difference in thickness of the material and voids caused by defects causes a difference in the amount and pattern of radiation that reaches the film. The radiographic image of the internal structure of the material will identify the defects in the object. Strict radiation protection procedure is followed throughout the operation.

THE NEED FOR QUALIFICATION OF INDUSTRIAL RADIOGRAPHER (IR):

**Saudi Aramco:** Part of the requirements of Saudi Aramco for applying Industrial Radiography job on its properties, as per SAEP-1141 [2], is that each Industrial Radiographer (IR) needs to obtain the Radiation Protection Permit (RPP) card. This card can’t be obtained only after passing radiation safety exam coordinated by the Radiation Protection Unit (RPU) of Environmental Protection Department (EPD) of Saudi Aramco. Regularly, RPU/EPD is arranging the exam two times a month and some times more. Also, IR have to repeat the exam every two years. Radiation workers of more than 20 Contractors are working on Saudi Aramco properties in the field of inspection and Industrial Radiography. Numbers of those IRs are more than 1000 and mostly are brought to the Kingdom from different nationalities. Thus, they have different background about radiation safety and different education levels. Their knowledge about radiation safety is varied as per their training in their companies and
before employment. Recently, contractors are trying to hire more IRs due to the increase in expected projects to be fulfilled within Saudi Aramco. Contractors are in continuous search for qualified IRs but their availability become rare due to the increased international demand. As a consequence, contractors started to hire radiation workers with low level of background and as a result the possibilities to pass the RPP qualification exam of RPU/EPD decreased. This in return, increases the load on the members of the RPU/EPD because they have to repeat the exams repeatedly for those who fail. This is costing Saudi Aramco and contractors more money, time and manpower. For instance, in year 2008, 566 radiation workers (RW) passed the exam out of 1083 candidates attended, passing percentage was 52%. Comparing to year 2006 the passing rate was 58%. Repeating exams for this number means preparation for 26 exams (assuming 20 RW/Exam). Every exam needs:

- Registration to participants,
- Confirmation of the registration,
- Preparation of questions,
- Reservation of exam hall in the hotel,
- Proctoring for one morning,
- Correction of the exams,
- Preparation of the results and
- Issuance of a RPP card or failure notice.

Saudi Aramco realized the heavy load raised by the large failure number and therefore in the new version of SAEP 1141 they added condition to those who failed which is to attend a course before repeating the exam.

**National Level:** KACST (the national regulatory authority) imposed new rules, applicable to all companies using radioactive sources, that a radiation workers training certificate from an authorized and a licensed training identity should be submitted as one of the conditions to obtain a Radiation Practice License (RPL) by the authority. It also requires a “refresh training” for the workers to be conducted regularly on yearly basis [3].

Due to the (1) previous Saudi Aramco rules, (2) governmental pre-condition on licensing of a facility and (3) the need of the market, SPSS submit a proposal with complete training manual to the national authority to establish the first national training course for radiation workers. The proposal and manual has been accepted and approved after amendment. Based on that, SPSS obtained the radiation worker training license shown in Figure 1. The license outlines the concepts and titles of 19 subjects to be covered during the training. These approved lectures are distributed on a three day course timetable as shown in Figure 2.

**SYLLABUS OF INDUSTRIAL RADIOGRAPHY (RWs) TRAINING COURSE:**

This is a 3-day intensive short course that combines lectures, tutorials with problem solving sessions and short reviews to train the attendees on the important aspects of radiation safety in the industrial radiography field.

The syllabus of the short course includes the following subjects:

1. Basics of Atomic Structure and Radioactivity,
2. Characteristics and interaction of radiation with Matter,
3. Radiation Units (Sv, Gy, Rad, rem, rontgen) and their relations.
4. Doses, dose rate, ALARA and dose limit.
5. Rules of protection from external radiation doses.
6. Biological Effects of Radiation on the Human Body,
7. Radiation Detection and Measurement including Personnel Dosimeters and Survey Meters,
8. Personnel Protection against Ionizing Radiation including the effects of Time Distance, and Shielding with emphasis on the concept of inverse square law and half-value layer,
9. Working Mechanisms of X-Ray and Gamma Ray Radiography Devices (Fixed and Mobile),
10. Transportation of Radioactive Sources,
11. Basic Rules of Industrial Radiography,
12. Radiography Accidents and How to Prevent them,
13. Radiation Safety Regulations in Industrial Radiography including GI 150.003 and SAEP-1141.
14. Daily needed working conditions like: release of radioactive sources from storage, zoning, calibrated survey meters, Alarm dosimeters, TLD, Permits (Radiation work permit and RPP), emergency procedure, and qualified radiographers.

**BENEFITS OF TRAINING THE IR WORKERS:**

The benefits’ of training the IRs and radiation workers in generals can be summarized as follow:

1- Knowing and fulfilling the rules of radiation safety in Saudi Aramco and on national level.
2- Knowing how to protect them selves and general public
3- Knowing how to handle and transport the exposure device safely,
4- Knowing the risk associated from the sources during the exposure in the field,
5- Knowing the strength of the IR source, its half-life and the related units.
6- Knowing responsibilities of the worker and his Radiation Protection Officer (RPO)
7- Knowing the complete setups in the operation area including the area zoning and boundary.
8- Knowing the calculation of the dose and the dose rate in different units
9- Knowing the dose limit for workers, the public & the main biological effects of radiation.
10- Knowing the standards and emergency procedures related to IR.
11- Knowing how to conduct radiation on survey around the exposure device and in the operation area.
12- Knowing the transportation procedure from the storage bunker to the field and backward.
13- Knowing others like rules of calibration of survey meters, leak test to exposure device and source, needed personal dosimetry and the needed record keeping.
14- Reduce the failure percentage between the candidates and save the times of the RPU who conduct the exam and save the operation time for the companies.
15- Unify the background level of different IRs regardless of their nationalities and companies.
CONCLUSION: Training of radiation workers, including IRs, will help Saudi Aramco, contractors and users of radiation sources in the Kingdom on how to reduce the risk from the use of radiation sources to the workers, public and environment. In addition, it will save the time of all parties, Saudi Aramco, contractors and workers, in obtaining the RPP card. The objective of the granted SPSS training licenses for RSO and RWs is to transfer the right radiation safety knowledge, based on 30 years of experience in this field, to the needed candidates and to serve the national interest.

REFERENCES:


**FIGURE 1:** SPSS radiation workers training license issued by the national regulatory authority in Saudi Arabia (KACST)
**TABLE 1.: Timetable of the radiation workers training course**

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