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Simulation-based behaviour-training in occupational risks prevention

Seguridad

This article describes the Asociación Nuclear Ascó-Vandellós II A.I.E. (ANAV)'s behaviour-simulation project as part of prevention-of-occupational-risks training. This project, a trailblazer in Spain, achieves effective integration of occupational risks prevention into induction job training.

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Power plants involve facilities, equipment and processes that might be of great complexity; they also generate risks that could potentially affect plant workers. In the case of a nuclear power plant the complexity is even greater and there are specific risks such as exposure to ionising radiation; these risks determine how the work is to be carried out (time restraints on carrying out certain tasks, etc). Furthermore the human factor has to be taken into account in all these risks, a factor that often looms large in accidents and incidents.

Another complicating factor is that companies of this type need to consider these risks not only in normal working conditions but also during fuel-reloading and maintenance activities when the station is shut down and the number of workers involved is multiplied. Risk situations also have to be taken into account. In a nuclear power plant, therefore, worker training plays a crucial role within the whole set of preventive procedures.

The human factor simulator is a basic tool for improving the training of the personnel working in a nuclear power plant

As in other firms, training has to be carried out under the aegis of article 19 of the Spanish Prevention of Occupational Risks Act 31/1995 (Ley de prevención de riesgos laborales), covering the theory and practice of the whole set of risks to which workers are or might be exposed when carrying out their work. Nonetheless, there are in fact few examples of the practical side being dealt with during induction training on occupational risks. In most cases training is restricted to the classroom exposition of a set of information and tips, etc, without proper integration of this knowledge into the workers' daily tasks and without considering the abovementioned practical side. Along these lines the Spanish Strategy of Health and Safety at Work 2007-2012 (Estrategia Española de Seguridad y Salud en el Trabajo 2007 – 2012) holds up training as "one of the essential pillars" of this strategy and ipso facto of the prevention of occupational risks in Spain. Objective 6 of this strategy underlined the need of having duly qualified and skilled workers, pointing out also that part of this qualification should "consist of soundly based training in the prevention of occupational risks, not only from the theoretical point of view but also in terms of the effective practice thereof".

Cultural Change in Safety

The appearance in 2009 of ANAV's Organisational, Cultural and Technical Reinforcement Plan (Plan de Refuerzo Organizativo, Cultural y Técnico: PROCURA) represented a complete rethink of the company's safety policy as carried out hitherto. This plan, incorporated as a top-priority activity within ANAV's strategic framework, includes a coordinated set of actions designed to reinforce organisational and cultural aspects, leading to an improvement in ANAV's operational safety and reliability. One of the ideas spawned by Plan PROCURA was to create a behaviour simulator (hereinafter, a human factor simulator). This simulator would stress the overriding importance of preventing human error in the operation of the nuclear power plant and show how the prevention of such errors would improve management of health and safety. It was therefore considered that simulation of the workers' activity inside the plant would be a good option for moulding worker behaviour, guiding them towards safe behaviour through a structured learning process.

The human factor simulator has been conceived as a fundamental tool for improving the training of personnel working in the nuclear power plant, whether own staff or the workers of contracted firms. It involves the holding of practical sessions in facilities containing similar equipment to that which exists in the nuclear plant. The idea is to drill workers in simulated situations that are similar to those they will find when carrying out their work, with the overall aim of encouraging safe behaviour and preventing human error. The human factor simulator was designed in light of the operational experience in the nuclear sector, taking its inspiration from the INPO models (Institute of Nuclear Power Operations) and various models of European and North American nuclear power plants containing simulators of this type. The simulator design process involved a multidisciplinary working team (areas of organisation and human factors, maintenance, planning, radiological protection, operation, training and prevention of occupational risks) which compiled information on visits to the various nuclear plants.

Training Stations

The simulator components are housed in a 1106 m2 building; it comprises eleven training stations where most of the simulator training is carried out.

1. Confined spaces.
2. Working at height.
3. Exclusion of foreign bodies.
4. Fire protection.
5. Radiological protection.
6. Clearances.
7. Human error prevention techniques.
8. Hoisting and movement of loads.
9. Electrical risk.
10. Chemical products.
11. Personal protection equipment and signage.

The simulator also has a hydraulic loop, a mock-up area, workshop-classrooms for practical assembly- and disassembly-exercises on the most common plant equipment and a sample of tools, personal protection equipment and banned material in the nuclear power plant. The idea of the latter is to bring fully home to trainees the reasons for the prohibition of this material.

The remit of the human factor simulator is to drill safe behaviour and prevent human error

All these facilities between them recreate the most usual manoeuvres in a nuclear power plant and drill human-error prevention practices, thereby reinforcing safe behaviour. Greater verisimilitude has been achieved by using recently replaced working equipment from the nuclear power plants of Ascó I, Ascó II and Vandellós II. On the basis of these facilities and working equipment a set of scenarios has been designed for detecting possible errors and unsafe behaviour and reinforcing safe working habits. These scenarios have been built up from operational experience of this plant and others. A crucial part in their design was played by ANAV's Prevention of Occupational Risks Department with the aim of reinforcing preventive habits among workers.

After the simulator had actually been built, it was then vetted by all the departments involved in its design and conception, with a final validation by INPO. Each scenario was also vetted by the heads of the corresponding Organisational Units and by their training coordinators and instructors.

Worker Training

The training process kicks off with the presentation of the whole training activity by an ANAV Manager, whose presence reinforces management expectations of the activity. After a brief explanation by the instructor of the basic aspects to be taken into account in the plants under review, a start is then made on task simulation in each one of the previously designed scenarios.

The task is carried out following the same organisational scheme as in real operational conditions: first and foremost an indication is given of the internal procedures to be followed and a work package is handed out with work orders and any corresponding permits. A pre-job meeting is then held with all workers involved, analysing and preparing the task to be carried out and the roles of each worker. Any necessary tools are then taken up and personal protection equipment donned before starting the tasks themselves. After the tasks have been completed, the instructor meets up with the supervisor to point out any deviations that might have come to light in relation to his/her responsibilities and duties in carrying out the task, solving any problems that might have cropped up. Finally the supervisor meets up with the workers in a post-job debriefing (with the instructor in attendance) to analyse any faults and discuss how to improve task execution.

The inclusion of a supervisor in each of these training activities is paramount. The supervisors' duties, within ANAV's organisation, include reinforcement of proper activity, the correction of improper practices and the encouragement of participation and communication between the personnel under their charge and the rest of the personnel. Their inclusion in these training activities cements the supervisors' role in aspects such as the prevention of occupational risks, given their vital role in carrying out the real tasks. Participation of supervisors in the training activities also chimes in perfectly with the need of across-the-board integration of all the firm's hierarchical levels into occupational risk prevention after the 2003 amendment of the Ley de Prevención de Riesgos Laborales.

The instructor, apart from making the initial explanation, is responsible for monitoring the execution of the simulated task, bringing any shortfalls to the supervisor's attention to act accordingly.

A total of 1750 workers have received practical training in the human factor simulator in its first year of operation

The drill ends with self-assessment by participants where they themselves analyse any mistakes made in carrying out the tasks, setting forth the correct way of carrying them out and improvements that might be tackled in the scenarios. This procedure means that the training process itself is fed back into a continual improvement of the training activity. Each drill lasts six hours, distributed among the various scenarios, workshop-classrooms, etc. varying to suit the particular training needs of the participating personnel in each case.

Faithful Scenarios

The scenarios have been conceived with the simulator stations and facilities in mind. Other conditions can be factored in to ensure that the scenario faithfully simulates plant situations: activation of alarms, the need of adopting forced postures, time restraints in carrying out the tasks or environmental factors such as high temperatures, high noise levels, etc). All these determining factors act as task impediments and bring the simulation even more closely into line with real working conditions inside the plant. Some small traps were even factored in, such as personal protection equipment or tools of the wrong sort or in a poor state, banned objects, etc, with the idea of applying the knowledge built up by the workers and safety logic, thus reinforcing recognition of those aspects that might impinge negatively on safety conditions.

As already pointed out, use of the simulator is not restricted to ANAV's personnel but also takes in the personnel of contracted firms; training activities are therefore carried out by teams made up by multidisciplinary personnel.

As for future developments of the simulator, new scenarios will undoubtedly have to be phased in to incorporate information from incidents and accidents as they occur. New simulator uses will also have to be defined: recreation of accidents, trying out new working methods and training for carrying out critical tasks, among others, will all help in pinpointing the causes of accidents and incidents and ensure tasks are carried out more safely and in the shortest possible time. All this will undoubtedly be conducive to increased safety of the personnel and the plant itself.

In the first year of its operation a total of 1750 workers have now been trained in the human factor simulator, adding up to over 10,000 practical training hours. ANAV's human factor simulator marks a milestone in the training of occupational risks prevention in Spain's nuclear sector, in terms not only of its objectives and approach but also its design and execution budget (a million euros). Another notable feature is the integration in a single training activity of aspects such as the prevention of occupational risks, human factors and radiological protection. Factors such as the focusing of worker training on error avoidance, participation of supervisors in the training activities and the huge number of risks and situations included all represent a great stride forward in terms of incorporating practical aspects into the training of occupational risks prevention.

The 11 stations of ANAV's human factor simulator

ANAV's human factor simulator comprises 11 training stations, each one of which simulates different scenarios from a specific part of the nuclear power plant posing its own particular risk. These are the following:

Station 1

Confined spaces

This has two separate spaces simulating a tank and a gallery or sewer. Practical working activities are carried out in them, rehearsing the steps to be followed in confined-space working and rescue techniques. Temperature conditions can be modified in this station (heat stress).

Station 2

Work at height

A training station prepared for explanation of the use of harnesses and ladders/stairs on site. Stress is laid on the scaffold identification tag number and prevention of falls from height in scaffold working.

Station 3

Exclusion of foreign bodies

This station drills practices to exclude foreign bodies and avoid the accidental introduction of potentially damaging objects into the equipment of the nuclear power plant.

Station 4

Fire Protection

Drills here involve the proper management of flammable material in due accordance with plant procedures (labelling, storage in airtight cabinets, etc). The station includes related signage and recreates measures for reducing the fire load in cubicles.

Station 5

Radiological protection

An analysis is made of the main principles of radiological protection and ALARA principles. A demonstration is also given of the entry into and exit from the radiological zone, the clothing to be worn and techniques to avoid contamination while dressing and undressing.

Station 6

Clearances

Station designed to steep participants in clearance and tagout procedures. Stress is laid on the various tagging systems and hold cards used during the clearance processes.

Station 7

Human-error prevention techniques

On a small console communication is drilled in three ways: the phonetic alphabet, abidance by plant procedures and other verifications and practices bound up with the prevention of human error.

Station 8

Hoisting and movement of loads

Load hoisting and movement drills are carried out on the simulator's bridge crane, looking at sling type and layout, etc.

Station 9

Electrical risk

A cubicle recreates a motor control centre with electrical switches of varying power to simulate situations faced by operators of electrical equipment.

Station 10

Chemical products

Using a set of materials available in the plant, this station runs through the various types of recipient used in the plant, the correct labelling thereof, the use of safety data sheets and safety indications for the storage of chemical products.

Station 11

Personal protection equipment and signage

A study is made of the different types of personal protection equipment (PPE) used in the plant, obligatory standards, their application in plant signage, etc. Information is also included on evacuation routes and emergency telephones.

TO FIND OUT MORE

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