General Nuclear Worker Training

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Course Description

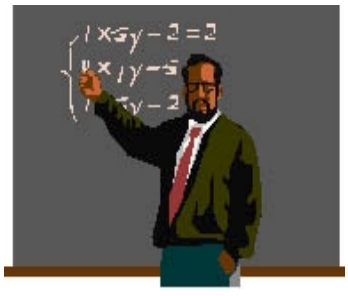
This course will provide the student with a general overview of the job knowledge requirements for a worker at a nuclear power plant. Roles of the various work groups are discussed along with the individual responsibilities of the nuclear worker. Overviews of the security and fitness for duty requirements are provided along with an introduction to basic radiological concepts.

Performance Objectives

Upon completion of this course the student should have a basic understanding of:

- Roles and responsibilities of the various station departments;
- The basics of plant security systems;
- Responsibilities of the nuclear worker;
- Industrial safety hazards at a nuclear power plant;
- Emergency preparedness;
- Fitness for duty requirements for nuclear workers; and
- Basic radiological concepts.

Introduction



Prior to being granted unescorted access to a commercial nuclear facility, a new employee or contractor must pass a written examination. This exam tests the workers general knowledge of the various facility organizations. Upon successful completion of orientation training and the written exam, the employee will Prior to being granted unescorted access to the plant but not in any Radiation Controlled Areas (RCA). In order to perform unescorted work in an RCA, the worker must take additional training and pass a written examination on radiation work practices. That is the subject matter for a different course and only basic Radiation Protection (RP) information is provided in the material for General Nuclear Worker Training (GNWT).

Although each commercial nuclear facility has developed their training modules for GNWT, a large amount of the information is standard for the industry. This has become necessary over the years due to the number of contract workers who move from plant to plant. This course will provide the generic information which is applicable to any plant.

Therefore, a new employee who has successfully completed this course will only have to address the minimal site specific topics in order to obtain unescorted access.

Course Content

A large percentage of the workforce in the commercial nuclear reactor industry is nearing retirement age. As most plants near twenty five and thirty years of service, so do many of the workers, creating wonderful opportunities over the next several years for a whole new group of nuclear workers. Most of the operating plants today are obtaining twenty year extensions to their current forty year operating licenses; thus, a good thirty year career lies ahead of an individual who enters the nuclear workforce today.

There are several requirements an individual must meet in order to obtain employment and, in turn, unescorted access to the nuclear facility Protected Area. The Protected Area is the fenced area around the nuclear plant and access is controlled and monitored by the plant security organization. The requirements for new workers include:

1. Fingerprinting
2. Criminal background check
3. Drug screening
4. Successful completion of General Worker training
5. Successful completion of Radiation Worker training

Upon successful completion of items 1 through 4, the worker will be granted unescorted access to the Protected Area but not into any Radiation Controlled Areas. Radiation Controlled Areas are areas within the Protected Area which require additional training to enter due to the presence of either radiation or loose contamination. This course is designed to aid the new worker in completing number 4, "Successful completion of General Worker training." A separate course is available for the worker who will be required to enter RCAs.

Each plant has their own training programs and their own general employee training modules; however, the bulk of the information is the same at each plant. This is due in large part to The Institute of Nuclear Power Operators (INPO), an industry oversight organization that has the responsibility for the accreditation of the nuclear training programs at each facility.

Due to the fact that large numbers of contract workers move from plant to plant to support refueling outages, much of the general employee training has been standardized; **HOWEVER,** to an employee new to the industry, the amount of information presented in the one or two days of training can be overwhelming. The course booklets are typically around a hundred and fifty pages and the student must obtain an 80% passing score on the exam. This course will help prepare an individual for that exam by providing a large amount of the generic information found at any of the plants.

Part 1. Roles and Responsibilities of the Various Station Departments

Plant Operations Department

The plant operators are the individuals who physically manipulate the plant components. The operators manipulate valves, circuit breakers, and other equipment necessary to safely operate the reactor and the numerous support systems.

The operators are the only personnel licensed to control the nuclear power levels of the reactor. Reactor Operators and Senior Reactor Operators must attend extensive training and then pass exams which are overseen by the Nuclear Regulatory Commission.

The Plant Operations Department is the owner of the safety tag program which isolates equipment for maintenance.

The Plant Operations Department approves what type of work is performed on the plant during reactor operations and during reactor shutdowns.

Maintenance Department

The Maintenance Department is responsible for repairing and maintaining the plant equipment. The maintenance workers perform predictive, routine and preventive maintenance of the plant's structures and of the electrical, mechanical, and instrumentation hardware within the plant.

The Maintenance Department personnel work very closely with the Operations Department to assure it is safe to remove equipment from service for maintenance, repair, or replacement.

Security Department

The Security Department is responsible for protecting the health and safety of the public from the threat of radiological sabotage as defined by the Federal Statutes (10CFR Part 73). It also has the responsibility to protect the utility company's assets and plant personnel.

The Security Department is responsible for site access and issues the employee badges that allow entry into the facility.

Training

The Training Department is responsible for conducting training and assisting the various plant departments in maintaining qualified personnel to perform the various tasks within the facility.

The Training Department maintains the training records for the site.

The Training Department teams with the various departments to develop training material and conduct the actual training.

Emergency Planning

The Emergency Planning Department is responsible for the development of the plans for dealing with emergencies which might arise at the nuclear station. Part of these plans includes the assignment of plant personnel to designated emergency positions, which require specific qualifications and training. It is the Emergency Planning Department's responsibility to assure that sufficient numbers of personnel are trained for these positions and available for "callout " 24 hours a day/7 days a week.

The Emergency Planning Department develops and conducts drills to practice the roles and responsibilities in emergencies.

Engineering

The Engineering Department is responsible for designing changes to the nuclear station and assuring that the licensing requirements and technical specifications for the plant are not impacted by the design changes.

The Engineering Department is also responsible for determining if the Nuclear Regulatory Commission is required to approve a design change to the station.

Quality

The Quality Department is responsible for assuring that the highest levels of quality work are performed at the plant. This is accomplished by inspection of replacement parts, and the inspection of work in progress in the plant to assure all standards have been met.

The Quality Department also conducts inspections of certain programs in various plant departments to assure that the program requirements are being met. A program consists of procedures which implement processes at the plant, such as welding. The inspectors will examine the documentation of work done by those procedures.

Industrial Safety

The Industrial Safety Department is responsible for the station's industrial safety programs. This is accomplished by maintaining written safe work practices in a safety manual, performing field inspections of work preparation and work in progress, and by sponsoring a plant safety program with participation by all work groups.

Part 2 Plant Security Systems

The physical land area of a commercial nuclear plant is divided into a number of distinct areas for security purposes. The analogy of a marksmanship target is often used to describe these areas. The innermost area akin to the bulls-eye on a target is called the Vital Area. The next outer ring is known as the Protected Area. The next outer ring of the target is known as the Owner Controlled Area.

VITAL AREA

The Vital Area contains structures, systems and components which are essential for the safe shutdown of the nuclear reactor. These components are often referred to as Safety Related Equipment with the connotation being "Nuclear" Safety not Industrial Safety. Examples of vital equipment include station battery banks and emergency high pressure injection pumps.

Access to vital areas is on a "need to be there" basis. Only plant personnel whose job functions require them to access Vital Areas are approved for entry. Entry is controlled by locked doors opened by security key cards. The key card also serves as your employee identification badge.

PROTECTED AREA

The plant proper is surrounded by a double fence with access controlled by the plant security department. All of the area within the double fence is known at the Protected Area. All personnel (and vehicles) that enter the Protected Area are searched and must have an approved access badge to enter.

OWNER CONTROLLED AREA

All of the area outside the Protected Area, usually to the company's property border is referred to as the Owner Controlled Area. Access to the owner controlled area is generally restricted to personnel who have a business need to enter. During heightened states of national security, access to the owner controlled area can become restricted to critical company personnel only.

Entering the Protected Area

A security badge is required to enter most nuclear stations. These badges are to be worn on the front of the body, between the neck and waist, and clearly visible. Lanyards are typically provided to hold the badges. If your security badge becomes lost or misplaced you must **immediately** notify plant security.

Prior to actually entering the Protected Area you will encounter the plant access area. Here, you and anything you wish to carry into the plant will be searched for forbidden material (contraband) which includes firearms, ammunition, explosives, corrosive materials, incendiary devices, drugs, alcohol, and incapacitating agents (mace, etc). The routine is pretty much the same as entering an airport with a few exceptions. You will be required to place all metal objects in a tray and put that tray through an x-ray machine along with any packages or briefcase you may carry. You will then pass through a metal detector and an explosives detector (not necessarily in that order). After retrieving your personal possessions from the x-ray machine you will be free to proceed to the protected area turnstiles. Here most plants use a magnetic swipe card, similar to your credit card, to identify the employee and open the locked turnstile into the Protected Area. These combination employee badge/access badge are referred to as keycards.

Unfortunately, each station has a different manor of issuing badges and how that badge is used to enter the plant at this point. At some plants you must go to a window in the search area and a plant security officer will issue you your keycard badge. At other plants, you are allowed to take your keycard badge home and you use it in combination with a biometric device to open the turnstile. These biometric devices use some form of scanning of a unique physical feature of your body to identify you. Some biometric readers scan your hand, some fingerprints while others scan the retina of your eye. Suffice it to say, that you will use your badge in some fashion to enter the protected area.

Part 3 Responsibilities of the Nuclear Plant Worker

The nuclear worker is a well trained professional. They experience a lifetime of continuous training to improve their skills and qualifications to do a variety of tasks at the station. Incumbent upon all workers is a set of industry norms or standards of behavior. Some of these are:

- Procedure Use and Adherence – Almost every task that is performed in a nuclear plant is done by the use of a written procedure. Workers are expected to follow the procedure without exception. If a flaw is found or suspected with the procedure, then work is stopped, the equipment is placed in a safe condition, and the procedure problem is resolved prior to starting work again. When using a procedure, further expectations are:
    - You have checked and validated that you have the latest procedure revision
    - You have thoroughly read and understand the procedure

- Compliance with Radiation Protection Guidance – Whether you are a trained Radiation Worker or not, all workers are required to obey all Radiological Postings, notices, and directions from an RP technician.

- Personal Protective Equipment (PPE) – *You are responsible for your own industrial safety*. Always use the required PPE for the job you are assigned. These may include: Safety Glasses, Hart Hat, Steel Toe work shoes, ear protection and gloves.

- Self-Checking –A standard at all USA nuclear plants, this is a technique used to assure yourself you are mentally and physically prepared to perform a task prior to performing the work. A memory aid to describe this form of self-check is called **STAR** and it stands for a four part process of Stop, Think, Act and Review.

    - Stop – Pause for a few seconds to plan what you are about to accomplish
    - Think – Think about what you are about to do and what the expected outcome is to be.
    - Act – Perform the task or action.
    - Review – Validate that you received the response you were expecting.

- Clear Communications – Clear communications are essential for ensuring that individuals who are taking actions with plant equipment are taking the correct action and are on the right piece of equipment on the right unit (many commercial nuclear sites have several plants on one site). Two techniques are used at most plants. They are:

    - Three Way Communication – This technique entails the recipient of instructions to perform a task repeating back those instructions to the originator, and awaiting confirmation that he/she accurately repeated back the instructions. Specific names of the individuals are used, along with specific names of the equipment and plant where the task is to be performed. The following is an example:

      Sam Supervisor: "Joe, I want you to go to the Unit 1 intake structure and manually stop the Number 2 Circulating Water Pump."
      Joe Worker: " Sam, I am to go to the Unit 1 intake structure and manually stop the Number 2 Circulating Water Pump"
      Sam Supervisor: "That is correct, Joe".

    - Use of the Phonetic Alphabet – Whenever instructions are being given and the equipment tag or designator ends in a letter, the

phonetic alphabet is used for that letter. The following is an example:

Sam Supervisor: "Pete, start the Unit 2, 1 Bravo air compressor." This is used in lieu of saying "1B air compressor" which could be confused with the "1D air compressor" as both "B' and "D" sound similar.

The following is the standard phonetic alphabet used at most nuclear plants in the USA.

The Standard Phonetic Alphabet

A – Alpha	**J – Juliet**	**S – Sierra**
B – Bravo	**K – Kilo**	**T – Tango**
C – Charlie	**L – Lima**	**U – Uniform**
D – Delta	**M – Mike**	**V – Victor**
E – Echo	**N – November**	**W – Whiskey**
F – Foxtrot	**O – Oscar**	**X – X-Ray**
G – Golf	**P – Papa**	**Y – Yankee**
H – Hotel	**Q – Quebec**	**Z – Zulu**
I – India	**R – Romeo**	

Part 4 Industrial Safety

This topic will acquaint the student with some of the industrial safety hazards that are present at a commercial nuclear facility and what the individual can do to reduce the threat from these hazards.

- High noise areas – These areas are posted throughout the plant. Repeated exposure to high noise areas can cause degraded hearing and up to permanent loss of hearing. The plant will provide some form of hearing protection with the most common being disposable ear plugs. Some stations require hearing protection throughout the entire power plant making ear plugs part of your "standard" PPE.

- Eye hazards – Safety glasses with wrap-around side shields are the standard for the industry. Many plants require that safety glasses be worn at all times. Other plants require safety glasses only where posted. Experience has shown that many eye injuries occur where an individual was not expecting to be exposed to any hazard (i.e.

looking up and having falling debris go into the eye).

- Compressed gas cylinders – These cylinders pose multiple potential threats. Some contain high flammable gas while others may contain poisonous gas. All full cylinders can become lethal missiles if dropped and the valve stem breaks. Make sure all gas cylinders are properly stored and secured.

- Steam leaks – Most pipe failures begin with a leak before a break. A steam leak can be a potentially lethal accident if not immediately isolated and corrected by trained personnel. There are several indicators of a steam leak, including: elevated temperatures, moisture on the walls and equipment, loud teapot whistle noise, and steam vapor or cloud. Report steam leaks to the control room immediately.

- Electrical Equipment – All plants have some form of safety tag program for isolating equipment for maintenance and repair. The program owner is the operations department. These tags are usually red in color. If you are required to perform work under a safety tag program you will be provided specific training prior to performing any work.

- Heat Stress – Power plants by their very nature can be hot places to work. High temperatures, combined with high humidity and strenuous work can lead to heat stress and even heat stroke. The safety department will usually establish stay times for work planned in hot areas. Stay times tell the worker how long he/she can perform work in the area before having to take a break. Additional measures may be taken, such as added cooling, ice vests, and drinking additional fluids prior to work.

- High pressure washers – Hydrolasers are high pressure washers which use water pressures up to 10,000, 15,000 and even 40,000 psi. These washers are used to decontaminate metal surfaces, tanks, and pits. There have been numerous serious injuries and fatalities with the misuse of this equipment. Often this equipment is skid mounted on a trailer outside the building and the high pressure hoses are run into the building and work area. These hoses should be avoided. Do not step on or drive over these hoses.

- Confined spaces - Power plants contain many areas that have limited access and potentially inadequate air supply. These spaces are posted. They include tanks, pits, condensers, and heat exchangers. A confined space is an area that has limited access (usually there is only one way in or one way out) and is not normally inhabited. Special training is required to enter a confined space. Under_no circumstances enter a confined space without the proper training.

- Trip and fall hazards – Trips and falls are two of the leading forms of injuries in the industrial safety category. Power plants contain numerous platforms, ladders, gratings and scaffolding which present fall hazards. Trips hazards are present when temporary power cables, compressed air lines and other obstructions are run on the floor.

- Rotating equipment – The plant contains many pieces of rotating equipment. A hazard is present in these areas when wearing bulky protective clothing which is worn to prevent the spread of contamination. Workers must be aware of their surroundings at all times to ensure that clothing does not become entangled in a piece of rotating equipment which could result in serious injury.

Part 5 Emergency Preparedness

Title 10 of the Code of Federal Regulations, Part 50 requires each nuclear station to have an emergency plan which the Nuclear Regulatory Commission (NRC) must approve. The purpose of this plan is to protect the public and the plant workers in the event of an emergency at the station. The area of concern is radiation exposure. The utility must conduct practice exercises with the surrounding county and state emergency management organizations to assure that the plan will work. These drills are graded by the NRC.

Emergencies have been classified into four categories and are the same for all nuclear plants in the USA. The four categories of emergencies are:

1. Notification of Unusual Event

   A Notification of Unusual event is declared when events are in progress or have occurred where there is a potential reduction in the level of safety at the site. No radioactive material releases have occurred nor are expected to occur due to the emergency. Therefore, there is no threat to the public.

   In this type of emergency there is sufficient time to take any required actions to prevent the emergency from worsening. Heightened awareness places the station in a mode for additional resources should they be required.

   Resultant actions from a Notification of Unusual Event are the notification of federal, state and local authorities.

2. Alert

   An Alert classification is declared when events are in progress or have already occurred which entail the actual or potential **substantial** degradation of the level of safety in the plant. Radioactive material releases, as measured at the plant site boundary, are expected to be a small percentage of the exposure levels limits established by the Environmental Protection Agency (EPA) in their Protective Action Guidelines (PAG). Therefore, there is no threat to the public.

   Resultant actions from an Alert are the prompt notification of federal, state, and local authorities. In addition, the emergency response facilities are activated: The Operations Support Center, the Technical Support Center, the Emergency Operations Facility and the Joint Information Center. The facilities, located both on the plant site and off the plant site, are manned by the specially trained Emergency Preparedness workers.

3. Site Area Emergency

   A Site Area Emergency is declared when events are in progress or have already occurred in which there are actual, or likely to be, major failures of the plant equipment necessary for the protection of the plant personnel and the public. If there are radiological releases, they are not expected to reach the EPA PAG limits as measured at the site boundary.

   Resultant actions from a Site Area Emergency are all the actions from the preceding emergency categories plus notification of the public via a system of sirens located in the areas neighboring the plant. The site will execute a Site Assembly and Accountability of all personnel on site.

4. General Emergency

   A General Emergency involves events in progress or which already have occurred that involve actual or imminent core damage and the potential for the loss of the integrity of the reactor containment building. Radiological doses will probably exceed those value limits in the EPA PAG.

   Resultant actions from a General Emergency include prompt notification of the NRC, state and local authorities, evacuation of non-essential plant personnel, and advisement to the public regarding actions to take.

The Site Assembly is the tool used for accounting for all personnel on site in the event of an emergency. All personnel must be accounted for within 30 minutes of sounding the alarm. Your nuclear plant will have specific procedures for how the response to a site assembly is conducted.

Part 6 Fitness for Duty Requirements for Nuclear Workers

The nuclear industry sets very high standards for its employees. Standards for unescorted access to the protected area of a nuclear facility extend to trustworthiness and reliability. Highest among these expectations is that an employee reports for work fit for duty. Just what does fit for duty or fitness for duty entail? There are a number of factors which can place an individual in a mental or physical condition where he/she is unfit for duty. Some of these include:

- Physical illness
- Recent alcohol consumption
- Lack of sleep
- Substance abuse
- Mental illness

Federal law requires that workers be fit for duty and one of the ways this is validated is by drug testing. If you go to work at a nuclear plant you can expect to be tested for alcohol and illegal drug use. There are four events which can trigger a drug test.

- New employee – When you are first hired you will be required to have both a drug and alcohol screening.
- Random – Half of the workers are randomly tested each year.
- Follow up – If you previously failed a test, have completed the necessary requirements to return to work, you will be expected to have several follow up tests to assure continued abstinence from abuse.
- For Cause - If your behavior indicates you are potentially unfit for duty, you may be tested to determine if alcohol or drugs are present in your system.

You may be subject to "call outs" when you work in the nuclear business. If you are called in the off hours to report to work it is your responsibility to notify the individual calling you (usually your supervisor) that you are unfit for duty. The general rule in the industry for alcohol consumption is the "5 hour rule". You are not to report to work if you have consumed any alcohol within the last five hours. Some plants may have more stringent rules. Violations of the fitness for duty rules can result in the loss of your job and in severe cases, such as drug dealing, being banned from the nuclear industry. The important lesson from this section is the concept: "If you work in the nuclear industry, you will be fit for duty."

Part 7 Basic Radiological Concepts

As you recall from elementary physics, all matter is composed of atoms. Atoms are in turn composed of three primary sub-atomic particles: the proton, the neutron, and the electron. The protons (which carry a positive charge) and the neutrons (which carry no charge) make up the nucleus of the atom and that nucleus is surrounded by a cloud of electrons. Most matter resides in a normal state with correct amount of neutrons, protons, and electrons for the particular element of consideration; however, sometimes an atom becomes unstable. When this happens the atom will emit energy in the form of particles. The atom does this in a natural order of nature to attempt to reach a stable state. These particles of energy are known as radiation.

Some basic definitions of terms are:

- Radiation – the energy that is emitted from an unstable atom
- Radioactive Material – substance, matter, material that emits radiation due to this natural decay process
- Contamination – the presence of radioactive material where it is not desired
- Decay – the process of the unstable atom emitting radiation as it seeks a stable state
- Dose – is the measure of, or amount of, radiation absorbed by the human body or an organ of the human body

There is a certain amount of radiation present everywhere we go in our lives. Radiation is given off by radon gas, cosmic rays from outer space, certain minerals in the earth such as granite, and as fallout from weapons testing. This everyday radiation is known as background radiation.

Nuclear workers who have successfully passed special training for radiation workers (subject matter which is beyond the scope of this course) are issued devices that record how much radiation they receive at work. These devices are called personal dosimetry devices. One such of these devices is the Thermoluminescent Dosimeter (TLD). The TLD has inside a special chip of material that when heated gives off a measured amount of light based upon how much radiation it has absorbed. These devices are worn on neck lanyards with your security badge and form the permanent record of your exposure.

All workers pass through a machine known as a portal monitor when they leave the protected area. These determine if the worker has any contamination on his person. It will detect both internal and external contamination.

Areas in the plant which have sources of radiation are posted with signs. These are the Radiological Controlled Areas or the RCAs. These signs mark the limits

of where you can travel in the plant without wearing the required personal dosimetry. The background of these signs will be yellow and the sign will have the tri-foil radiation symbol.

Glossary of Terms

- Biometric – the electronic measurement of human body attributes to establish identity
- CFR – Code of Federal Regulations
- Contamination – the presence of radioactive material where it is not desired
- Decay – the process of the unstable atom emitting radiation as it seeks a stable state
- Dose – is the measure of, or amount of, radiation absorbed by the human body or an organ of the human body
- EPA – Environmental Protection Agency
- INPO – Institute of Nuclear Power Operators
- Owner Controlled Area – the plant property outside the double fences surrounding the plant
- PAG – Protective Action Guides – a manual developed by the EPA defining the appropriate responses for radiological and nuclear incidents.
- PPE – Personal protection equipment
- Program – a set of procedures which implement a required set of tasks such as welding
- Program Owner – the department responsible for administrating a program
- Protected Area – the area within the double fences which surround the power plant
- NRC – the Nuclear Regulatory Commission
- Radiation – the energy that is emitted from an unstable atom
- RCA – Radiation Controlled Area
- Radioactive Material – substance, matter, material that emits radiation due to this natural decay process
- STAR – Stop, Think, Act, Review
- TLD – (Thermoluminescent Dosimeter)- a device for recording radiation exposure
- Vital Area – areas of the plant containing equipment necessary for the safe shutdown of the reactor

Conclusions

Like many industries, the nuclear industry has its own jargon and ways of doing things; however, due to the consequences of not doing things right the first time, adherence to the rules and standards of behavior are mandatory. The amount of information that must be learned in a short amount of time can be intimidating to a new employee. This course has provided a good introduction to the expectations to which you will be held accountable at a commercial nuclear facility and should make your first few days there a little less stressful. One final nugget to take away from this course is that the nuclear industry respects people who say "I don't understand this, would you help me?" Never be afraid or embarrassed to ask for help or direction because the person you asked for help has been there and done that.