

STUDY GUIDE

Rev. 24 - July 2001

This student guidebook is provided as a ready reference only and will cover MOST of the material presented in the Nuclear General Employee Training class. It is expected that students remain familiar with ALL N-GET material to work safely at Exelon Generating Stations.

Nuclear - General Employee Training

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I. INTRODUCTION

- ◆ Because you will be working at a nuclear station, you are required to complete Nuclear General Employee Training (N-GET). It is a federal law, that if you require unescorted access to a nuclear station, and are issued radiation dosimetry, you must receive some special training. Exelon's N-GET training program meets these requirements. This training program is designed to provide the information you need to keep yourself and the plant safe and secure. N-GET training is divided into the following units:
 - ◇ Fitness for Duty
 - ◇ Nuclear Security
 - ◇ Industrial Safety
 - ◇ Fire Protection
 - ◇ GSEP
 - ◇ Quality Programs
 - ◇ Radiological Protection and
 - ◇ Practical Applications, includes a protective clothing exercise, and proper whole body monitoring.

- ◆ Depending on your need for access, you will be required to take specific portions of the N-GET program. N-GET is divided into two levels. Plant Access Training, or PAT N-GET, is designed for those who do not require access into the Radiologically Posted / Radiologically Controlled Areas of the plant. It is very important to remember that if you only have PAT level N-GET, you will not be granted unescorted access into any Radiologically Posted/Radiologically Controlled Area.

- ◆ Plant Access Training consists of the following topics:
 - ◇ Fitness for Duty
 - ◇ Security
 - ◇ Industrial Safety
 - ◇ Fire Protection
 - ◇ GSEP
 - ◇ Quality Programs and
 - ◇ Radiation Protection Orientation.

- ◆ Radiation Worker Training or RWT N-GET is required for all persons requiring unescorted access into Radiologically Posted/Radiologically Controlled Areas of the plant. This level of training, along with PAT topics, includes the following:
 - ◇ Radiation Protection Introduction
 - ◇ Biological Effects
 - ◇ Radiological Risks
 - ◇ ALARA
 - ◇ Radiation Exposure Limits
 - ◇ Dosimetry and Instrumentation
 - ◇ Contamination Control
 - ◇ Radiation Work Permits and Survey Maps and
 - ◇ Practical Exercise.

- ◆ To successfully complete Plant Access Training, you will be required to take 2 exams. One exam which covers Security, Industrial Safety, Quality Programs will consist of at least 25 questions and the second exam



with 15 questions will cover FFD. Each exam requires a minimum score of 80% to pass. You will not be permitted to use any notes or reference materials when you take this exam. Normally, this test should be completed in 45 minutes.

- ◆ In order to successfully complete Radiation Worker Training N-GET, you will be required to complete an exam on Radiation Protection basics. This exam will consist of at least 50 questions and also requires an 80% to pass. RWT should be completed within 60 minutes. As with Plant Access Training exam, you will not be allowed to use notes or reference material. Additionally, successful completion of RWT N-GET requires that you demonstrate proficiency in the proper donning and removal of protective clothing, as well as proper whole body frisking.
- ◆ Your Exelon N-GET Study Guide provides information useful to you while working at the station. Site specific information for each of the stations is available in the ROG Specific Study Guides. You may want to refer to your Study Guide prior to taking your N-GET exam. You should keep your Study Guide for possible future reference. You are responsible for being familiar with the Site Specific material if you should go to work at a different Exelon station.

II. POWER STATION OVERVIEW

Exelon is committed to assuring the supply of electricity to its millions of customers in the Midwest and Mid-Atlantic regions. To do this, we have established a network of nuclear generating stations.

Nuclear generating stations use uranium fuel pellets to produce the steam for generating electricity. The nuclear stations are:

Mid-West Region - Braidwood, Byron, Clinton, Dresden, LaSalle, Quad Cities,
Mid-Atlantic Region – Limerick, Peach Bottom, Oyster Creek, Three Mile Island

Identify locations of major station buildings

A nuclear generating station contains numerous buildings and areas that house the equipment and personnel necessary to operate the plant. Some of these buildings and areas are:

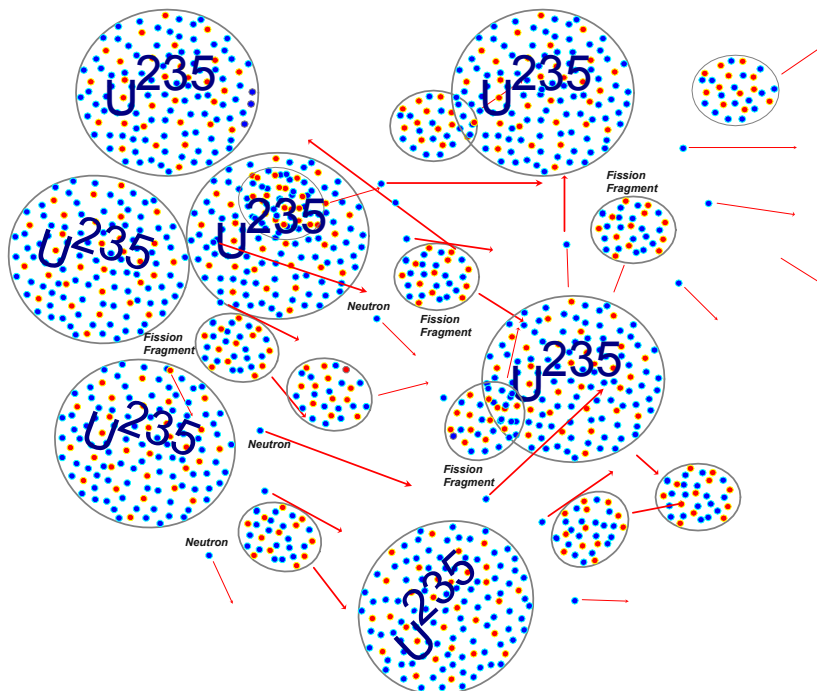
- ◆ The Turbine Building: this building houses the main turbine, the generator, and support equipment such as the main condenser and condensate pumps.
- ◆ The Reactor Building: this building houses the nuclear reactor, isolation valving, reactor instrumentation, and safety related equipment.
- ◆ The Auxiliary Building or Aux Building contains essential auxiliary operating equipment including, in some cases, the control room.
- ◆ Security Access Points are the only places where you may enter the protected areas of the site. You must pass through security and comply with proper security requirements at all times. The most common security access points are located in the security guard house.
- ◆ The Radiologically Posted Area (RPA) or Radiologically Controlled Area (RCA) is the part of the plant that contains radiological areas and is restricted to those personnel who have completed the Radiation Worker Training level of N-GET. This level of training is usually referred to as RWT N-GET.

Drug Screening Reporting Site: All personnel requiring unescorted access to a Nuclear facility or certain specified emergency reporting centers must participate in the Fitness For Duty program. This program requires Initial, For Cause, and Random Fitness For Duty Testing.

SITE MAPS ARE LOCATED IN ROG SPECIFIC STUDY GUIDES

Discuss the process for the generation of electricity

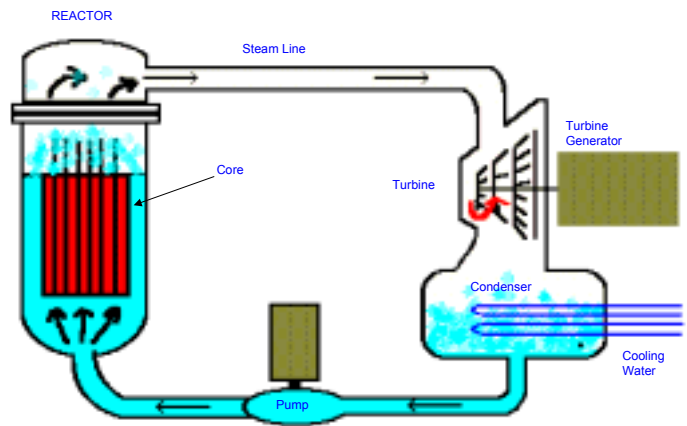
- ◆ The basic operation of the power station involves the conversion of nuclear energy into electricity.
- ◆ In a nuclear power plant, heat energy from a nuclear reaction is used to change water into steam, which, in turn, drives the plant's turbine.
- ◆ The mechanical energy of the spinning turbine is converted to electrical energy in the generator.
- ◆ Nuclear energy is energy released from the fission process. Fission occurs when a neutron strikes the nucleus of a uranium atom. The atom will usually split into two smaller atoms and release additional neutrons causing a chain reaction.
- ◆ When a uranium atom splits, energy is released in the form of heat and radiation which heats the water to produce steam. The steam causes the main turbine and the generator attached to spin, producing electricity.



- ◆ Exelon operates two types of nuclear generating stations; Boiling Water Reactors (BWRs) and Pressurized Water Reactors (PWRs).

Boiling Water Reactors

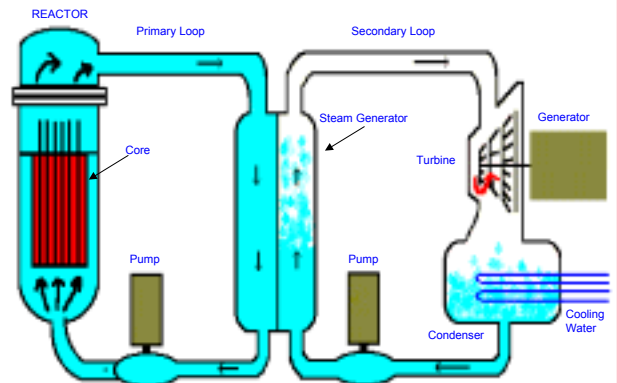
- ◆ A BWR uses a single loop system, in which water actually boils in the reactor core. The resulting steam is piped directly to the turbine, which powers the generator. This steam is then cooled in a condenser and returned to the reactor core to begin the cycle again. Exelon's BWR stations are Dresden, Quad Cities, LaSalle County, Limerick, Oyster Creek, and Peach Bottom.



bwr.wmf

Pressurized Water Reactors

- ◆ A PWR uses a double loop system. In a PWR, water is heated in the reactor core within the primary loop. This heat is then transferred through a heat exchanger to the secondary loop, where steam is created. This steam is then piped to the turbine. After the steam passes through the turbine it is condensed and filtered, and returned to the heat exchanger to repeat the cycle. Braidwood, Byron, and Three Mile Island are PWR plants. Because of the differences in design between Boiling Water Reactors and Pressurized Water Reactors, radiation protection requirements may vary.



pwr.wmf

Identify appropriate communication systems

There are several types of communications systems.

- ◆ Station emergencies shall be reported directly to the Control Room.
- ◆ The Public Address (PA) system is for official business only and provides the capability to make important announcements.
- ◆ In-station radio systems may be used by some departments for communication.
- ◆ Lengthy business discussion between employees are communicated by use of the telephone system.

REFER TO THE ROG SPECIFIC STUDY GUIDE(S) FOR SITE SPECIFIC INFORMATION REGARDING COMMUNICATION SYSTEMS

III. Stations Organization and Administration

State the function of the following departments

You should become familiar with some of the main departments and programs within a nuclear plant and their primary functions.

- ◆ The **Operations Department** operates plant equipment; placing protective tags, controls reactor power, and approves most work done at the plant.
- ◆ The **Maintenance Department** keeps the plant in proper operating condition by repairing plant equipment, such as instruments, pumps, valves, security equipment, motors, and performing preventive maintenance.
- ◆ The **Radiation Protection/Radiological Controls Department** assists workers in minimizing their radiological exposure and in minimizing the spread of radioactive contamination. This Department performs activities such as monitoring various areas of the station for radiation levels, controls access and work in radiation areas, airborne contamination and contaminated areas, prepares and controls Radiation Work Permits, and controls access to and from the Radiologically Controlled (RCA) or Radiologically Posted Area (RPA).
- ◆ The **Training Department** assists line organizations by presenting training courses, maintaining training and qualification records, and conducting training programs to qualify personnel to perform the tasks necessary in their job.
- ◆ The **Security Department** controls access to and from the protected areas, the issuance of badges for site access and maintains control of security doors as well as performing other security functions.
- ◆ The **Nuclear Oversight Department (NO)** checks the quality level in the station to ensure it meets standards and codes. NO performs activities such as monitoring station activities to ensure they are performed correctly, performs program reviews, and inspects safety-related parts and supplies.
- ◆ The **Emergency Preparedness/Emergency Planning Department** ensures that adequate plans and trained personnel are available to protect the health and safety of the general population in case of a plant emergency.

- ◆ And finally, Safety is everyone's concern. The station's **Occupational Safety and Health/Safety Committee/Industrial Safety** provides oversight of Exelon's Industrial Safety Program by performing such functions as checking air quality, evaluating industrial accidents and heat stress concerns.

State individual responsibilities on procedural compliance and the use of approved documents

- ◆ A nuclear power plant is a complex facility. For safety and security reasons, it is important that you comply with all company policies and procedures. This means complying with such company policies as:
 - ◇ Operating equipment only when you are qualified and authorized to do so by the control room or specifically authorized by procedures.
 - ◇ Obtaining proper authorization for work to be performed on plant equipment before you start the job.
 - ◇ Reporting problems observed in the station regarding station equipment, programs, or methods using the station problem reporting program.
 - ◇ Comply with all Radiation Protection and Security rules established by those departments.
 - ◇ Use of all tobacco products is permitted in specifically designated areas only.
 - ◇ Only authorized material shall be read during work periods.

**REFER TO THE ROG SPECIFIC STUDY GUIDES(S) FOR SITE SPECIFIC INFORMATION
REGARDING INDIVIDUAL RESPONSIBILITIES**

State the policy on procedure compliance and use of controlled documents

- ◇ All work in the plant must be performed in accordance with an approved work document. Approved documents include procedures, maintenance work packages, plant modifications, and radiation work permits, among others. If work cannot be performed in accordance with the approved document:
 - * Stop the work.
 - * Place the job in a safe condition.
 - * Contact your supervisor
 - * Resolve the problem.
- ◇ Individuals are responsible for verifying the latest approved revision of a document is being used to perform the work by reviewing the document prior to performing the task and verifying all necessary tools and parts are available.

REFER TO THE ROG SPECIFIC STUDY GUIDE(S) FOR SITE SPECIFIC INFORMATION

State responsibilities for station cleanliness and housekeeping

- ◇ Each individual is expected to keep his/her own workspace as neat as possible and to clean up after completing a job in the station. Leave a work area cleaner than when it was found.

Discuss Self-Check

- ◇ It is an Exelon company policy that all work to be performed should include the "Self Checking" process. Self checking is a mental process that is used anytime a task is about to be performed that could have adverse consequences if done incorrectly.
- ◇ Examples of where self-checking should be used are in manipulating a valve or component, connecting test equipment, opening panel doors and entering RCAs/RPAs.
- ◇ The steps involved with self-checking are:

S	Stop - Plan and prepare.....	S	Stop
T	Think - think about what you are about to.....	U	Understand
A	perform and what you are supposed to be performing.....	R	Respond
R	Act - perform the action.....	E	Evaluate
	Review - verify that the response.....		
	was correct for the action taken.		

REFER TO THE ROG SPECIFIC STUDY GUIDE(S) FOR SITE SPECIFIC INFORMATION

IV. FITNESS FOR DUTY PROGRAM

State Access Authorization (AA) and Fitness for Duty (FFD) requirements

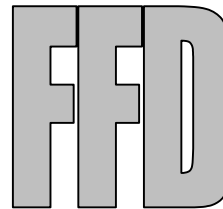
Federal law, Part 10CFR26, requires each utility licensee operating a nuclear facility to:

- Provide reasonable assurance that personnel who are granted unescorted access to a nuclear station are reliable and trustworthy and are neither under the influence of any substance (legal or illegal) nor mentally or physically impaired from any cause that may adversely affect their ability to safely and competently perform their duties.
- Per 10CFR73.56 and 10CFR57, individuals seeking unescorted access require completion of a background investigation, psychological evaluation, finger printing, and credit checks.
- Establish a fitness for duty program to create an environment free of drugs, alcohol, and their effects; and to provide employees with assistance for fitness for duty related problems.

You are to be fit for duty by being neither mentally nor physically impaired from any cause that could adversely affect safe, competent job performance.

Impairment may be the result of:

- Physical illness
- Mental illness
- Improper diet
- Substance abuse
- Fatigue



10CFR26 mandates individuals who require unescorted access to the protected area participate in drug and alcohol testing.

Recognize the hazards associated with the abuse of drugs and alcohol

- ◆ The negative impact of substance abuse is felt by the work force.
- ◆ Consider in the work environment alone, substance abusers:
 - ◆ Have FOUR times as many accidents
 - ◆ File FIVE times as many workers' compensation claims
 - ◆ Use THREE times the number of sick benefits
 - ◆ Are absent or tardy TWICE as often
 - ◆ Make TWICE as many mistakes as non-abusers
- ◆ Drugs can have a significant impact on your job performance. The use of drugs or other chemicals can result in impaired judgment, impaired vision, changes in reflexes, and/or reduced analytical ability.

State the company's AA and FFD policy

Exelon's Fitness for Duty policy dictates that Exelon employees and contractors alike abide by the appropriate policy requirements.

EXELON DRUG AND ALCOHOL POLICY:

Exelon has maintained a strong commitment to providing a safe workplace for all personnel. In carrying out that commitment, it is our goal to establish and maintain a work environment that is free from the effects of alcohol and drug abuse. Exelon is requiring badged personnel to sign and acknowledge this drug and alcohol statement which provides reasonable assurance that personnel working at Exelon Nuclear Power Plants are reliable, trustworthy, and not under the influence of any substance, legal or illegal, or mentally or physically impaired from any cause which in any way adversely affects their ability to safely and competently perform assigned duties. Any badged individual who engages in any of the following acts may be in violation of the company Fitness For Duty or Access Authorization program and will not be allowed access to Exelon's nuclear power stations.

- ◆ The illegal use, sale, or possession of narcotics, drugs, or controlled substances while on the job on Exelon Company property is a violation of the Drug and Alcohol Policy and/or the Fitness For Duty Program. Station parking lots are Exelon property. Any illegal substances will be turned over to the appropriate law enforcement agency and may result in criminal prosecution.
- ◆ Anyone under the influence of alcohol, or who possesses or consumes alcohol on the job, has the potential for interfering with their own as well as their co-workers safe and efficient job performance. Consistent with existing Company practices; such conditions will be proper cause for administrative action up to and including denial of access.
- ◆ Anyone who possesses alcoholic beverages on Exelon company property is in violation of the Exelon Drug and Alcohol Policy.
- ◆ Anyone who consumes alcoholic beverages within a five (5) hour period preceding any scheduled working tour, or consumes alcoholic beverages during the period of any working tour, or is under the influence of alcoholic beverages during any working tour is in violation of the Exelon Fitness For Duty Program.
- ◆ Off-the-job illegal drug use which could adversely affect an employee's job performance or which could jeopardize the safety of other employees, the public, or Exelon equipment is proper cause for administrative or disciplinary action up to and including denial of access to Exelon property.
- ◆ Abuse of legal prescription or over-the-counter drugs which could affect an individual's performance or which could jeopardize the safety of other individuals, the public, or Company equipment is a violation of the Exelon Fitness For Duty Program.

- ◆ Anyone arrested or that is involved with illegal off-the-job drug or alcohol activity may be considered to be in violation of the Company Drug & Alcohol Policy or the Fitness for Duty Program. In deciding what action to take, management will take into consideration the nature of the charges, the employee's present job assignment, the employee's record with the Company, and other factors relative to the impact of the employee arrest upon the conduct of Company business.
- ◆ Drugs which are illegal under federal, state or local laws include, among others, marijuana, heroin, hashish, cocaine, and hallucinogens. Depressants, stimulants, and other controlled substances not prescribed for current personal treatment by an accredited physician also fall under this rule.
- ◆ Individuals undergoing prescribed medical treatment with a controlled substance should report this treatment to their supervisor. The prescribed use of controlled substances as directed by a physician is naturally not grounds for disciplinary action, although it is important for the company to know such use is occurring.
- ◆ All individuals, vehicles, property, equipment, and areas on Exelon nuclear station property are subject to search. This includes all parking areas. Refusal by an individual to permit a search of their person, property, vehicle, or area is violation of Company Policy.
- ◆ Individuals will be subject to drug and alcohol screening test. Refusal to submit to any test is a violation of the Exelon Fitness for Duty Program. A positive test result, indicating that an individual was present on Exelon nuclear station property while under the influence of drugs or alcohol, is considered a violation of the Fitness For Duty program.
- ◆ Individuals called out for unscheduled work must inform the person calling whether or not they are fit for duty or have consumed alcohol.

For Site Specific information on the Access Authorization (AA) and Fitness For Duty (FFD) policy, refer to the ROG Specific Study Guides(s)

State the methods used to implement the AA and FFD program

- ◆ The primary parts of the AA and FFD program are:
 - ◇ Chemical Testing
 - ◇ Behavior observation by managers and supervisors
 - ◇ Training and
 - ◇ Employee Assistance Program(EAP)/Employee Assistance Services (EAS).
- ◆ Exelon ensures specimen collection, documentation, and testing is conducted in strict compliance with the Fitness for Duty Program.
- ◆ Chemical testing provides a means of detecting and deterring substance abuse in the work place.

- ◆ Types of chemical tests are:
 - ◇ Pre-employment/Pre-access: conducted prior to employment or prior to being granted unescorted access to the plant's protected area.
 - ◇ Random: conducted in an unannounced fashion at various times during the day, night, weekends, and holidays.
 - * If you are selected for a random test, you, your supervisor or point of contact will be notified. If your supervisor or point of contact is notified, they will notify you of the scheduled test time.
 - ◇ For Cause: conducted following any observed behavior indicating possible substance abuse, critical incidents involving property damage, personal injury or safety-related issues, after the confirmation of the odor of alcohol by a supervisor, and after receiving credible information that an individual is abusing drugs, alcohol or trying to subvert the FFD Program by using adulterants.



- ◇ Follow-up: conducted at unannounced intervals to ensure an individual is maintaining continued abstinence from the use of drugs and/or alcohol.
- ◆ If you refuse to participate in the FFD testing process, unescorted access will be immediately suspended. A refusal is considered a violation of the FFD program.

NOTE

When you are selected and scheduled for a random or follow-up test, you must report promptly. You may only miss the test if you are not on the plant site and are not expected to return for the day or there is an emergency approved by your supervisor. You may NOT request time off once notified of a random or follow-up test.

- ◆ The collection site is staffed with personnel who will provide individuals with detailed instructions on how the collection process will be handled.
- ◆ The chemical testing process screens for the following substances: alcohol -- marijuana -- cocaine -- opiates -- phencyclidine -- amphetamines.
- ◆ Urinalysis will be used for all substances except alcohol. A breathalyzer will be used to read the blood alcohol concentration in a person's breath. The company limit is 0.04% blood alcohol concentration (BAC).

For site process if breathalyzer indicates a positive result, refer to the ROG Specific Study Guide(s).

State the purpose of the EAS/EAP

- ◆ Employee Assistance Services (EAS)/Employee Assistance Program (EAP) provides assessment, short-term counseling and treatment monitoring for FFD related issues. Only Exelon employees are eligible for the EAS/EAP. Employees may request assistance from the EAS/EAP (self-referral) or can be referred by their supervisor or by the company medical staff. Contractors can check with their supervisor on the availability of an employee assistance program in their company. Refer to the ROG Specific Study Guide(s) for further information.
- ◆ If the EAS/EAP staff determines that your condition constitutes a hazard to yourself or to others, 10CFR26 requires notification of company management even if you are a self-referral.
- ◆ For additional information on the company's EAS/EAP, see your supervisor. To obtain information or get help, contact the EAS/EAP staff directly.

State the effects prescription and over the counter drugs and diet may have on test results

- ◆ Use of prescription medication or commonly purchased over-the-counter drugs, such as cold medicine, may have an impact on testing. For this reason, it is important that you list all drugs you have taken in the last 30 days on the chain of custody form.
- ◆ Since certain prescription medicine, over-the-counter medication and dietary consumption may cause a positive test result, you must be aware of your medications and keep your supervisor informed as part of the fitness for duty program. For reporting medications, refer to the ROG Specific Study Guides(s).
- ◆ Prescription and non-prescription drugs (i.e. aspirin) taken into the station must be in a properly labeled original container.
- ◆ A donor with a confirmed positive test due to valid medication will be offered the opportunity to discuss this with the MRO and verify the validity of the prescription.
- ◆ Hemp product ingestion will not be accepted by the MRO as a valid excuse for a positive marijuana test.
- ◆ If under medication and there are signs of job impairment and the work function may be endangered by this use, a Supervisor should temporarily assign an employee to a suitable work function.
- ◆ Some states have passed initiatives to legalize marijuana and other schedule I drugs for treatment. USNRC rules preempt state law and accordingly these initiatives do not affect application of 10CFR26 program requirements.



State the role of the Medical Review Officer (MRO) in the FFD Program

- ◆ Medical Review Officer (MRO) is a licensed physician who is responsible for reviewing all positive chemical test results and recommending individuals to EAS/EAP.

For addition role descriptions, refer to the ROG Specific Study Guide(s)

State the consequences of non-adherence to the FFD policy

If you violate the FFD policy, you can be suspended, have your unescorted access denied, and be referred to EAS/EAP.

For site policy on consequences to non-adherence to the FFD policy, refer to the ROG Specific Study Guides(s)

State the rights, roles and responsibilities of the individual with regards to the FFD program

- ◆ The Regulation prohibits consumption of alcohol for at least five hours preceding scheduled work and during the tour of duty. This does not assure someone who quit drinking five (5) hours before reporting to work will be fit for duty. The positive threshold for alcohol is .04 BAC. Therefore, it is possible to consume a significant amount of alcohol, stop drinking for five (5) hours and still test positive for alcohol. Even though the five-hour requirement was met, a positive breath test will result in a FFD violation and denial of access.
- ◆ It is self-incumbent that each individual voluntarily coming to work outside their normal work hours has not consumed alcohol within the previous five hours and is fit for duty. If alcohol has been consumed, the individual shall request an alcohol test upon site arrival prior to entering the protected area.
- ◆ You may be called in as needed for unscheduled work. You are responsible for informing your supervisor if you have consumed alcohol within the past five (5) hours or any other condition which in their judgment may impair their ability to safely perform assigned duties, including use of prescription medications, illnesses, sleep deprivation, or any other condition. Refer to the ROG Study Guide(s) for further site information on call-outs.
- ◆ If contacted at home to discuss a work related issue, you are responsible to alert the caller if you are uncomfortable about responding due to alcohol consumption, illness, use of prescription medication, sleep deprivation, or any other condition.

- ◆ Notify your supervisor of any problems such as mental stress, fatigue, or illness that may affect your fitness for duty, or your ability to safely and competently perform your duties. If you are undergoing prescribed medical treatment with a controlled substance, you should report this treatment to your supervisor. Refer to the ROG Specific Study Guide(s) for site requirements on reporting medication.
- ◆ Prevent and report actions that threaten our company or co-workers (includes reporting personnel with symptoms of substance abuse).
- ◆ Report to your supervisor instances of violation of the FFD program and/or procedures that might adversely impact safe operation of the plant.
- ◆ The decision to report the detected odor of alcohol should not be based on whether the odor is either slight or strong. When alcohol is detected, it is your responsibility to immediately get a supervisor involved. Failure to tell a supervisor after you detect the odor of alcohol on someone is a violation of the FFD Program and will result in your denial of access.
- ◆ Report any previous denial of unescorted access, positive chemical test, or involuntary participation in a substance abuse treatment program.
- ◆ If you have been arrested for a city ordinance violation, misdemeanor, or felony (except non-injury traffic or parking offenses), PROMPTLY report the arrest to your immediate supervisor. For site specific information on reporting arrests, refer to the ROG Specific Study Guide(s).
- ◆ Cooperate with the Chemical Testing program. Failure to do so may result in discharge and/or denial of unescorted access. Individuals providing specimens that have been adulterated or substituted are considered to be in violation of the Fitness For Duty policy and will be denied unescorted access.
- ◆ You also have the right to privacy at the collection site unless there is reason to believe that you will tamper with, alter, or substitute a specimen.
- ◆ Personal information collected for the FFD program will be protected and will not be disclosed except as required by the appropriate procedure.
- ◆ You shall report a leave of absence of thirty (30) days or more to your supervisor prior to leaving if you are not in a Continual Behavior Observation Program.

Examples Include:

- * Vacation for more than 30 days
- * Leave of absence for any reason
- * Working from home

Identify commonly used drugs

- ◆ **Cannabis:** A plant which grows wild throughout most tropic and temperate regions of the world. The plant is brilliant green in color with an odd number of saw-tooth edged leaves. Examples of cannabis include: hashish, hashish oil, and marijuana. Paraphernalia used include: small pipes and roach clips to hold rolled cigarettes.
 - ◇ Signs of Cannabis use include:
 - * Bloodshot eyes, dilated (wide) pupils
 - * Appearance of intoxication or disorientation
 - * Euphoria
 - * Odor of burnt marijuana or hemp
 - * Relaxed inhibitions

- ◆ **Stimulants:** Stimulates the central nervous system. Used medically for the treatment of narcolepsy, obesity, and hyperactivity in children. Examples of stimulants include: caffeine, nicotine, amphetamines, methamphetamine, some over-the-counter diet pills, and cocaine. Paraphernalia used includes: glass pipe, spoon, razor blade, needles, straws, and rolled dollar bills.
 - ◇ Signs of Stimulant use include:
 - * Increased alertness or excitation
 - * Euphoria
 - * Irritability
 - * Mood swings
 - * Risk taking due to overconfidence

- ◆ **Depressant:** Depresses the central nervous system. Used medically for the relief of anxiety, irritability, tension, and insomnia. Examples of depressants include: barbiturates, Valium, quaaludes, and alcohol.
 - ◇ Signs of Depressant use include:
 - * Slurred speech
 - * Disorientation
 - * Lowered inhibitions
 - * Bloodshot-watery eyes
 - * Odor on breath (alcohol)

- ◆ **Narcotic:** Used medically to relieve pain and to treat diarrhea. Examples include: opium, heroin, codeine, morphine, and paregoric. Paraphernalia used includes a syringe and pipe.
 - ◇ Signs of Narcotic use include:
 - * Constricted or narrow pupils of the eyes
 - * Droopy eyelids
 - * Euphoria
 - * Drowsiness
 - * Nausea

- ◆ **Hallucinogen:** Synthetic or natural drugs that distort the perception of objective reality. Use may lead to delusions and visual hallucinations. Examples of hallucinogens include: psilocybin, LSD, phencyclidine (PCP), and mescaline. Paraphernalia used includes: syringes, small glass containers, and pipes.
 - ◇ Signs of Hallucinogen use include:
 - * Blank stare or rapid eye movement
 - * Delusions and visual hallucinations
 - * Poor coordination or perception of time and distance
 - * Flashback or ‘trips’

Identify signs which may indicate sale, use, or possession of drugs

- ◆ Drug dealers cannot be stereotyped. Drug dealers come from all classes and walks of life. Drug sales may take as little time as it takes for a handshake.

- ◆ Escorts and ALL plant workers need to be aware of the various locations in which people can conceal drugs on themselves. You should suspect persons who appear nervous, as if they are hiding something. Some common drug concealment locations include:
 - ◇ Shoes, socks, and underwear
 - ◇ Cigarette and chewing tobacco packs
 - ◇ Pens and flashlights
 - ◇ Headbands of caps and hard-hats
 - ◇ Purses, briefcases, and lunch boxes

- ◆ If the sale, use, or possession of drugs is observed in plant or on company property, report this IMMEDIATELY to your supervisor or Security.

Identify behavioral observation techniques

◆ **Behavior**

- ◇ Escorts may have many different people from all walks of life placed in their care. Therefore, for the safety of the plant and plant personnel, ESCORTS should pay attention to the visitor and be aware of any unusual behavior patterns and breaches of security.
- ◇ In addition to escorts, SUPERVISORS are responsible for implementing parts of the Behavioral Observation Program. This includes:
 - * Evaluating an employee's fitness for duty.
 - * Documenting of any incident(s) indicating possible aberrant behavior.
 - * Ensuring employees perform tasks in a reliable and trustworthy manner.
- ◇ Because of this requirement, supervisors and escorts, alike, must develop and refine their observation skills and techniques.

◆ **Aberrant Behavior:**

- ◇ Aberrant behavior is defined as behavior, which varies or deviates, from normal behavior.
- ◇ Since escorts probably are not familiar with their visitor's normal behavior, escorts must rely upon some sign or indication that may indicate aberrant behavior. Signs of possible aberrant behavior include:
 - * An individual who tends to be INFLEXIBLE.
 - * Acts IMPULSIVELY without thought or consideration of consequences.
 - * MEMORY LOSS.
 - * Feelings of PERSECUTION, PARANOID BEHAVIOR, OR EXTREME FRIGHT.
 - * Carries on entire conversations with IMAGINARY people or animals for considerable periods of time.
 - * SEES visions, SMELLS strange odors, HEARS voices.
 - * DANGEROUS or DESTRUCTIVE behavior.
 - * INAPPROPRIATE behavior for a given situation.
 - * Any other factors such as GUT FEELINGS or BODY LANGUAGE.
- ◇ If a visitor exhibits unusual behavior, appears impaired, or if the odor of alcohol is identified on the visitor, immediately contact a supervisor or security and continue to escort the individual at all times until the individual exits the protected area.

◆ Behavioral Observation:

- ◇ Behavioral observation is a function WE perform every day. A key to behavioral observation is to be aware of the people who work with you, and more importantly, the individuals who may work for you, if you are a supervisor.
- ◇ Possible areas that could assist in detecting degradations in job performance, impairment, or changes in behavior include:
 - * Absenteeism - Increases in absenteeism and tardiness. Frequent use of vacation time. Leaving work area more than necessary. Unexplained disappearances from the job.
 - * Work Patterns - Using more time to complete work. Missing deadlines. Inconsistent quality of work. Uneven work patterns. Difficulty in remembering mistakes. Poor judgment.
 - * Physical Signs or Conditions - Untidiness, weariness, exhaustion. Sunglasses worn constantly or at inappropriate times. Changes in appearance after lunch or breaks.
 - * Accidents - Higher than average accident rate (both on and off the job). Taking needless risks. Disregard for the safety of others.
 - * Actions - Withdrawn or improperly talkative. Violent behavior, argumentative. Avoidance of talking with supervisor regarding work issues.
 - * Mood - Depressed or extremely anxious all the time. Wide mood swings. Mood changes after lunch or break.
 - * Relationships to Others on the Job - Complaints from coworkers, clients, or the public. Avoiding and withdrawing from peers. Overreacting to real or imagined criticism.
- ◇ Occasional instances of these behaviors do not necessarily reflect a problem. It is a PATTERN of these symptoms over time linked to PERFORMANCE PROBLEMS on the job that supervisors should note, document, and take action on.

Explain the supervisor's role in the FFD program

Recall that behavioral observations and job performance problems should be documented. In fact, documentation is a supervisory TOOL used to identify patterns, including performance decline or other work-related problems.

◆ **Identify steps taken by a supervisor to initiate appropriate corrective action.**

- ◇ Ideally, supervisors should encourage employees to seek assistance through the EAS/EAP BEFORE problems occur. This may prevent a major deterioration of performance plus it demonstrates the supervisor's commitment to the well being of his or her workers.
- ◇ EAS/EAP provides assessment, short-term counseling, and treatment monitoring for Fitness for Duty related issues.
- ◇ Situations may develop where a supervisor has no choice but to take corrective action with employees under his or her control.
- ◇ Supervisors may have to 'step in' and correct a situation via an interview, making a referral to EAS/EAP, or taking action on Fitness for Duty concerns.
- ◇ Supervisory Steps for Corrective Action:
 - * **The following are some recommendations to consider when interviewing an employee about behavior-related performance problems.**
 - ⇒ Pre-plan the interview session with a review of the employee's records.
 - ⇒ Review the company policies and procedures concerning your employee's job performance.
 - ⇒ Consult with Human Resources and your manager about job performance problems.
 - ⇒ Make an appointment to discuss your concerns about job performance with the employee.
 - ⇒ Anticipate defensiveness during the session. Give specific instances of behavior-related job performance problems.
 - ⇒ Try to show genuine empathy rather than sympathy.
 - ⇒ Make specific suggestions about how to change the employee's behavior that affects job performance.
 - * **EAS/EAP Referral:**
 - ⇒ If an Exelon employee continues to show signs of behavior changes or problems, contact EAS/EAP staff to make a supervisor referral. The supervisor should continue to document changes in the employee's current performance. If behavior continues to deteriorate, contact the Medical Review Officer (MRO).
 - ⇒ Advise your management of the steps you have taken and the documentation collected. With your management's support, determine the next course of action regarding further discipline or assistance for the employee.

* **Handling of Fitness for Duty Concerns:**

- ⇒ The following steps are guidelines that can be used if supervisors suspect an employee may not be fit for duty. If supervisors have specific concerns or questions, they should contact Human Resources, the Medical Review Officer (MRO), or the Security Department.
- ⇒ Supervisors should not diagnose the cause of an employee's problem, but are responsible for timely action once a problem is detected or reported.
- ⇒ Once the supervisor or escort becomes aware that the individual's fitness is questionable, immediately remove the individual from work activities. The individual shall be escorted at all times until the concern is satisfactorily resolved or until the individual exits the protected area. Involve upper management of your company with the situation and contact Security.
- ⇒ If safety is not threatened, try to have at least one other person, preferably a member of supervision, observe the individual's behavior.
- ⇒ An employee may become belligerent when confronted. This may lead to personnel injury or damage to plant components. If you feel that the encounter may lead to physical problems, request assistance from another management person or Security and escort the employee from the protected area.
- ⇒ Notify Human Resources or Security for Exelon employees. Refer to the ROG Specific Study Guide(s) for further information.
- ⇒ If the individual refuses to submit to a medical evaluation or displays threatening behavior, the supervisor should escort the employee from the protected area and direct Security to revoke unescorted access.
- ⇒ The supervisor should instruct the individual that he or she is suspended pending further investigation.
- ⇒ If the sale, use, or possession of illegal drugs or alcohol is suspected; or if drugs, drug paraphernalia, or alcoholic beverages are found on site, immediately confiscate and control the contraband and notify Security.
- ⇒ Following any incident, prepare a detailed record of all actions. This includes documenting statements, dates, times, witnesses, and all pertinent facts. Management should be notified of the incident as soon as possible.
- ⇒ If the Fitness For Duty concern is received in the form of an allegation of a past occurrence, rather than an immediate behavioral concern, refer to the ROG Specific Study Guide(s) for further information on allegations.
- ⇒ A For Cause drug and alcohol test is required when the odor of alcohol has been detected on an individual and confirmed by a supervisor. Breath alcohol testing is required to begin within one (1) hour. Security will arrange for the for cause drug and alcohol test. Unescorted access will be suspended pending test results.
- ⇒ The FFD rules apply equally to everyone regardless of their title or position.

- ⇒ Management has the responsibility to deal with FFD concerns in a timely manner.
- ⇒ Due to the transient nature of contracted work, contracting and vendor firms may not always have a full complement of management on site. In the absence of on-site company management, contractor and vendor supervisors shall notify Security, the Exelon cognizant contact or other Exelon management following the occurrence of any Fitness for Duty issues or events.

For site specific information on a supervisor's role regarding the FFD program, refer to the ROG Specific Study Guide(s)



V. NUCLEAR SECURITY PROGRAM

State the basic purpose of the ComEd Security program

The basic purpose of the Exelon Security program is to assure the protection of the health and safety of the public. This is accomplished by:

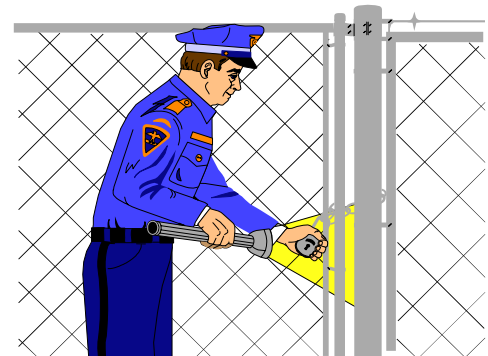
- ◆ Protecting against acts of radiological sabotage.
- ◆ Protection of station personnel.
- ◆ Protection of company assets.

Identify the areas of the station that are controlled by Security, including: the OWNER CONTROLLED AREA, the PROTECTED AREA, and VITAL AREAS

These are the three Security areas that are generic to all Exelon Nuclear facilities:

The OWNER CONTROLLED AREA

- ◆ This is all the property that is associated with the station and is owned by Exelon, including:
 - ◇ Parking lot areas (all vehicles are subject to search)
 - ◇ Switchyards
 - ◇ Cooling lakes
- ◆ Exelon has the legal right to request individuals to leave this area and to prosecute for trespassing if they refuse.



The PROTECTED AREA

- ◆ An enclosed area into which access is controlled.
 - ◇ Access requires a badge issued by Security.

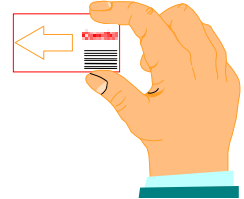
VITAL AREAS

- ◆ These areas contain equipment essential to the safe operation of the plant.
- ◆ Access to a vital area is allowed only if an individual has been authorized access.
- ◆ Any activity that will breach the boundary of the protected or vital areas must be approved by Security in advance or performing work. If an opening in a security boundary is discovered, notify Security immediately.

Refer to the ROG Specific Study Guide(s) for additional information regarding security areas.

Recognize the types and purpose of security badges

- ◆ A security badge is an electronic key to various areas of the plant.
- ◆ You will be responsible for the control and custody of your security badge at all times.
- ◆ You must ensure you have your badge with you when you report to the station for your next work shift.
- ◆ The security badge must be displayed facing out, on the upper front portion of the body on the outer garment.
- ◆ If you remove your outer garment, ensure that the security badge is transferred to the new outer garment.
- ◆ If you **lose** your security badge while at work, IMMEDIATELY notify Security.
- ◆ If you **lose** your security badge while away from work, report to Security at the Main Access Facility upon your arrival at work.
- ◆ If you **find** a security badge, IMMEDIATELY notify the Security department.
- ◆ If you notice someone without their security badge, notify the individual and Security and escort the individual until Security arrives.
- ◆ Examples of security badges are:
 - ◇ A badge that allows unescorted access to the station.
 - ◇ A visitor badge
 - * The visitor badge does not require any background investigation or training and the visitor must be escorted by an authorized individual while in the Protected Area.



For site specific information on security badges, refer to the ROG Specific Study Guide(s)

Identify materials/items that are prohibited and when searches are performed

- ◆ **CONTRABAND** is defined as federally prohibited material such as:
 - ◇ Explosives
 - ◇ Weapons of any kind
 - ◇ Incendiary devices
- ◆ Examples of items that are **PROHIBITED** at Exelon Nuclear facilities include:
 - ◇ Alcoholic, non- alcoholic beverages and their empty containers
 - ◇ Illegal drugs and drug paraphernalia
 - ◇ Ammunition of any kind
- ◆ **CONTRABAND** and **PROHIBITED** materials must NEVER be brought into the OWNER CONTROLLED AREA



- ◇ Possession of any of these items on Exelon property is grounds for dismissal.
- ◆ Three methods are used to assist in the detection of prohibited items and to help accomplish personnel searches:
 - ◇ Explosive detectors
 - ◇ Metal detectors
 - ◇ Personal searches

Anyone alarming the explosive or metal detectors will be searched by the Security force in accordance with station procedures.

An individual will not be allowed access to the protected area until the source of the alarm has been identified.

- ◆ Airport style x-ray machines are used to search all hand-carried items passing through the Main Access Facility
 - ◇ It may be necessary to open some items to determine their contents.
 - ◇ To facilitate the search process, all hand-carried items containing bottles or cans should be opened when passing through the x-ray.
 - ◇ If it becomes necessary to hand search an item, the Security guard will maintain control of the item until the search is complete.
- ◆ All employees on Exelon property are subject to search at any time. The following rules apply:
 - ◇ All searches are by implied or expressed consent. Signs are posted at the entrance explaining Company policy.
 - ◇ Any employee who refuses to be searched will be escorted from the property.
 - ◇ Random searches may be conducted at any time.

For additional site specific information on searches and prohibited materials/items, refer to the ROG Specific Study Guide(s)

Describe the procedure for entering and exiting the station

REFER TO ROG SPECIFIC STUDY GUIDE(S) FOR ENTERING AND EXITING THE PROTECTED AREAS

- ◆ Personnel requiring unescorted entry to a vital area must possess a security badge and be properly authorized to enter that area.
- ◆ Visitors entering a vital area must be escorted by an authorized individual.
- ◆ If you are not certain if you have authorization for unescorted entry into a vital area, check with Security before attempting to enter.

REFER TO ROG SPECIFIC STUDY GUIDE(S) FOR ENTERING AND EXITING THE VITAL AREAS

State the policies involved with escorting visitors

- ◆ If you are escorting a visitor, be sure you observe the following requirements:
 - ◇ Ensure the visitor is properly displaying the visitor badge.
 - ◇ Keep the visitor in sight at all times.
 - ◇ Visitors are not allowed to enter a RPA/RCA unless authorized.
 - ◇ Ensure the visitor follows all applicable policies and procedures.
 - ◇ When exiting the station, do NOT leave the visitor until he/she has left the PROTECTED AREA.
- ◆ Visitors ***shall*** be escorted at all times when within the PROTECTED AREA.
 - ◇ At times escort responsibilities may be transferred to another individual.
 - ◇ All station procedures must be followed when transferring visitors.
- ◆ If you encounter a visitor without an escort, assume escort responsibilities, and then notify Security IMMEDIATELY.

For the escort to visitor ratio, refer to the ROG Specific Study Guide(s)

Identify possible Security violations and their consequences

- ◆ Tailgating is when more than one individual attempts to pass through a Security door or turnstile using only one security badge.
 - ◇ Tailgating is a security violation and should NOT be attempted.
 - ◇ All persons passing through a Security door must log into the card reader using their own security badge.

Other possible Security violations could include:

- ◆ Tampering with locks and other security equipment.
- ◆ Holding a vital door open too long.
 - ◇ If the door must be held open for a period of time, contact Security first.
- ◆ Improper closing of doors.
 - ◇ Always ensure the door closes completely after passing through, particularly if there is a pressure difference on the two sides of the door.
 - ◇ Challenge the door by pushing and pulling, but do not turn the doorknob.
 - ◇ Improperly closed doors will cause a Security alarm which is then reportable to the NRC.
- ◆ Unauthorized or multiple attempts to enter a security area may cause a security alarm to sound.
 - ◇ If access is not granted on the first attempt, call Security personnel and follow their instructions.
- ◆ Using the card reader to enter, then failing to exit properly.
- ◆ Opening an emergency exit.
- ◆ Failure to comply with Security requirements may result in the denial of unescorted access.

***State the Security roles and responsibilities for both the Security guard force and for all station workers***

- ◆ SECURITY PERSONNEL have the major responsibility for Security at the station.
 - ◇ They perform routine patrols and control access of personnel and vehicles to the Protected Areas.
 - ◇ They monitor Security computer console activities and respond to Security alarms.

- ◆ ALL PLANT PERSONNEL must comply with all Security requirements and watch for apparent Security violations or deficiencies.

YOU must report any observed or known Security violation or deficiency to Security immediately.

It is NOT your responsibility to physically restrain Security violators.

- ◆ Security may grant permission to bring any vehicle into the Protected Area (PA).
 - ◇ If leaving a vehicle unattended in the PA, the authorized operator shall keep the key in their possession when not in the ignition.
 - ◇ An unattended vehicle with the ignition key in the vehicle is a serious security violation.

Refer to the ROG Specific Study Guide(s) for site specific information regarding security roles and responsibilities

Identify and discuss the usage of Safeguards Information

- ◆ Information concerning the protection of strategic nuclear material and power reactors is classified as “SAFEGUARDS INFORMATION”.
 - SAFEGUARDS INFORMATION:
 - ◇ Is protected on a ‘need to know’ criterion based on 10CFR73.
 - ◇ Usually has a red and white striped border on the cover page.
 - ◇ Is identified with a unique stamp at the top and bottom of each page.
 - ◇ This material shall NOT be divulged by anyone.
- ◆ When in use, this material must be under the direct control of an authorized individual.
- ◆ While unattended, this material SHALL be stored in a GSA approved locked Security storage container.

Desks or toolboxes are NOT adequate!

- ◆ If you find unattended SAFEGUARDS INFORMATION, take control of it, (don’t read it) and contact the Security Administrator IMMEDIATELY.

Please contact the Security department if you have any questions or concerns involving Security issues.

VI. INDUSTRIAL SAFETY

Discuss your industrial safety responsibilities

◆ INDIVIDUAL RESPONSIBILITIES

- ◇ You have responsibility for your safety.
- ◇ Any questions regarding Station policy should be directed to your supervisor.



◆ Reporting Problems

- ◇ If you should discover an unsafe working condition, correct it if you can, or report it to your supervisor.
- ◇ A few examples of problems that should be reported are:
 - * missing safety sign
 - * trip or fall hazard
 - * frayed electrical cord
 - * missing guardrail or handrail
 - * unsafe scaffolds
 - * improperly placed ladders
- ◇ If you are ever involved in a "near-miss" accident (that is, you almost have an injury), report it to your supervisor so it can be evaluated and actions taken to prevent recurrence.

◆ Personnel Injuries

- ◇ If you ever discover someone who is seriously ill or injured, you should immediately call the station emergency number and inform them of the nature of the first aid emergency. Be certain to clearly state the victim's location.
- ◇ All injuries, regardless of how small they seem, must always be reported to your supervisor immediately.



◆ Adherence to Safety Instructions

- ◇ Use good housekeeping habits
- ◇ Keep tools and other work items off floors and out of aisle ways
- ◇ Adhere to safety instruction, procedures, and permits.
- ◇ Adhere to requirements for using personal protective equipment (PPE).

Any violation of Exelon's safety instructions is considered a major violation of company policy and is subject to disciplinary action up to and including termination.

Station management expects all employees to use all applicable permits for a required task. This includes welding, propping a fire door open, or entering a confined space. Always get the necessary permit and authorization before starting the job.

- ◆ Observation of Safety Postings Barriers, Tags and Signs
 - ◇ Warning signs or barriers are used throughout the plant to warn you of potential dangers.
 - ◇ Always read and obey posted warnings.
 - ◇ Caution tags are used for information and equipment protection. When working in the plant, take care to read and obey any Caution tags you may find in an area before starting work.
 - ◇ “Out Of Service” (OOS) and “Do Not Operate” tags are used to ensure personnel safety or to prevent equipment damage by establishing the position of barrier valves or switches. Operating components with OOS or “Do Not Operate” cards on them may cause injury, death, or equipment damage.
 - ◇ Never hang, remove, or clear a safety tag unless it is done with the permission of the Control Room.
 - ◇ Authorization must be obtained from the Control Room before starting work on equipment or components having a safety tag attached.
 - ◇ Other barriers to warn you or potential hazards include yellow and black safety rope, yellow railings and flagging.

You are expected to follow all instructions posted in the plant for the safety of you and your coworkers.

- ◆ Personal Protection Equipment
 - ◇ Experience also shows that most injuries will involve the head, feet, eyes, and hands.
 - ◇ Wear personal protection equipment in the plant.
 - ◇ Wear personal protection equipment properly.

- ◆ Safety Equipment
 - ◇ Safety Equipment is installed near specific hazards and other equipment for emergency use. Examples include first aid kits, emergency showers and eyewash stations. Never tamper with emergency safety equipment.
 - ◇ Emergency Showers and eyewash stations are located to wash spilled chemicals off your skin and out of your eyes and may be activated by either a foot pedal, hand lever or pull chain.
 - ◇ If use of an emergency shower or eyewash station is needed, contact the emergency number, enter the shower or place your face near the fountains and pull the chain or depress the lever. Flush the affected area for a minimum of 15 minutes.
 - ◇ Know where the safety equipment is and how to operate it prior to starting a hazardous job.

Refer to the ROG Specific Study Guide(s) for additional information regarding industrial safety responsibilities

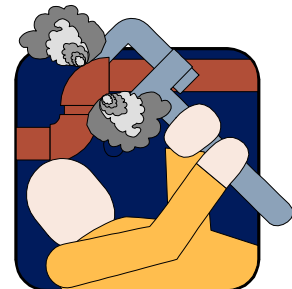
Recognize and discuss methods for reducing the risk involved with the following industrial hazards.

- ◆ Asbestos
 - ◇ A fiber used on the fabrication of lagging, insulation, and gaskets.
 - ◇ Is an airborne fiber that can cause severe problems if deposited in the lungs.
 - ◇ Exposure can cause serious health problems.
 - ◇ Follow the station asbestos work procedures.

- ◆ Lead
 - ◇ Lead can be found in coatings, solder, flux or as radiological shielding.
 - ◇ Inhalation and/or ingestion of lead fumes/particles can lead to acute and/or chronic health problems.
 - ◇ A pre-job assessment is required where the possibility of lead exposure exists.
 - ◇ Additional training is required to enter Lead Work Areas.

- ◆ Electrical Hazards
 - ◇ Electrical power used in the plant ranges from a few volts to thousands of volts.
 - ◇ Work on energized equipment requires special clothing, gloves, and personal equipment.
 - ◇ Working on energized equipment is extremely hazardous and requires authorization from management. Always assume all conductors, circuits, and equipment are energized.
 - ◇ Some conductors are imbedded in the concrete and other structures in the plant. If you need to drill into one of these structures, make sure there aren't any electrical conductors in it before you start.
 - ◇ Never touch an individual who is in contact with a live electrical circuit.

- ◆ Steam Leaks
 - ◇ Some indications of a steam leak are:
 - * visible vapor coming out of a plant component
 - * whistling noise
 - * increased area temperatures
 - * moisture on walls or ceiling
 - ◇ Use caution when in an area containing a steam leak.
 - ◇ If you find a steam leak, report it to the Control Room.



- ◆ Confined Spaces
 - ◇ May contain a life-threatening atmosphere
 - ◇ Meets the following criteria:
 - * any space not intended for continuous human occupancy
 - * any space having a limited means of entry or exit
 - * large enough and so configured that a worker can bodily enter and perform assigned work
 - ◇ Entry into a confined space is not permitted unless the requirements of the confined space permit are met and you have completed the confined space training program.



◆ Trip and Fall Hazards

- ◇ Piping, conduits, ropes, cables, work on elevated equipment, and unsecured ladders are only a few examples of trip or fall hazards.
- ◇ When working where there is a 6-foot fall potential, additional fall protection is required.
- ◇ Workers should check with their supervisor before using specialized equipment.
- ◇ Protective measures include postings, fall protection equipment, temporary platforms for elevated work, and scaffold usage.



◆ Heat Stress

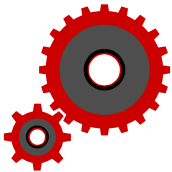
- ◇ The stay time, or the length of time permitted at a work site, may be limited to protect you against heat stress.
- ◇ Minimize the risk of heat stress illness by drinking plenty of fluids, using cooling devices such as fans and ice vests, and by limiting the amount of time you are exposed to the heat environment.
- ◇ If you are working in a hot and/or humid area and begin to feel overheated or dizzy, inform your co-workers and move to a cooler area and rest.

◆ Compressed Gases

- ◇ Stay clear of any relief or blowoff valves.
- ◇ Be sure hoses are in good repair, and do not direct compressed air at any part of the body.
- ◇ Store compressed gas cylinders in an upright position and ensure the cylinders are tied off or are secured to prevent falling over.
- ◇ Move compressed gas cylinders with a cart designed for compressed gas cylinders.
- ◇ Do not store compressed gas bottles exposed to the weather or direct sunlight.
- ◇ Never lift a compressed gas cylinder by its protective cap.
- ◇ Keep caps in place when the cylinder is stored or moved.



◆ Rotating/Moving Equipment



- ◇ Do not wear loose clothing or jewelry that could get caught in moving machinery or equipment.
- ◇ Accessible rotating equipment should be provided with physical barriers or guards to prevent personnel contact.

◆ High Noise

- ◇ When in a high-noise area, ear protection is required. High noise areas should be posted. In general, if you must raise your voice to talk, then you should wear hearing protection.

◆ Falling Objects

- ◇ Plant equipment, scaffolding, tools, and other objects are examples of what could fall and cause an injury.
- ◇ Minimize the potential of falling material by using equipment such as scaffold toe boards, safety screening, tool lanyards and good housekeeping.

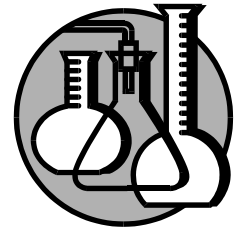


◆ Eye Hazards

- ◇ Chipping, grinding, burning, and welding are only a few examples of activities that require special eye protection. Note that working on some energized electrical equipment also requires additional protection.
- ◇ Wear your safety glasses and goggles or a face shield.

◆ Hazardous Chemicals

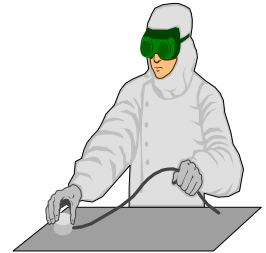
- ◇ The National Fire Protection Association (NFPA) 704 labeling system indicates the presence of hazardous materials at fixed storage locations. Each of the colored blocks contains a number that identifies the severity of the hazard. 4 is the most severe, 0 is the least severe hazard.
- ◇ Chemicals used in the plant include acids, caustics, cleaners, and petroleum.
- ◇ Some indications of a potential chemical hazard are:
 - * liquid spills
 - * labeled or unlabeled containers
 - * unusual vapors or odors
 - * posted chemical storage areas
- ◇ Always follow the label's instructions.
- ◇ Never mix chemicals.
- ◇ All chemicals used on site must have an Material Safety Data Sheet (MSDS) with information on:
 - * physical hazards
 - * protective clothing and equipment needed
 - * storage requirements
 - * spill and leak procedures
 - * respiratory protection
- ◇ Obtain information about MSDS through your supervisor.
- ◇ Contact your supervisor prior to entering a posted chemical area to ensure you are authorized.
- ◇ Hazardous materials must be disposed of according to regulations. Contact your site chemical control contact for information on proper disposal of chemicals. Never pour anything down a drain without appropriate permission.
- ◇ Training, labeling, chemical control programs, and protective equipment reduce the risk of injuries.



- ◆ Transportation of Hazardous Materials
 - ◇ Diamond shaped placards are attached to the vehicle containing the hazardous material.
 - ◇ Additional training may be required if you required to transport any hazardous material (e.g., compressed gas cylinders, radioactive material, etc.) over a public road on behalf of the company.

- ◆ Hazardous Waste Operations and Emergency Response (HAZWOPER)

- ◇ If you believe a spill or release of a hazardous chemical and/or substance has occurred, move a safe distance away and call the station emergency phone number and identify:
 - * who you are
 - * the location of the incident
 - * whether there are any injuries and
 - * the name and approximate quantity of the hazardous material.




- ◆ Bloodborne Pathogen Awareness


Hepatitis B (HBV) and Human Immunodeficiency Virus (HIV) may be transmitted when disease organisms enter the body through mucus membranes or through breaks in the skin. HBV can cause a potentially fatal liver disease. HIV causes Acquired Immunodeficiency Syndrome (AIDS) which can also be fatal.

- ◇ Could occur if you are exposed to a co-worker's open sore or if you have direct contact with their bodily fluids containing infectious material.
- ◇ Additional training is required for personnel whose job requirements could cause them to come in contact with bio-hazardous material.
- ◇ If you think you have been exposed to potentially infectious material, use the following guidelines:
 - * Don't panic!
 - * Inform your supervisor.
 - * Inform Exelon's Medical staff. The Medical staff will determine your exposure and advise you of any follow up testing that may be required.


REFER TO THE ROG SPECIFIC STUDY GUIDE(S) FOR ADDITIONAL INFORMATION ON METHODS FOR REDUCING RISK INVOLVED WITH POTENTIAL HEALTH AND INDUSTRIAL HAZARDS


State plant policy regarding the use of the following personal protective equipment and how it is worn

- ◆ **Hard Hat** 
 - ◇ To ensure maximum employee protection, hard hats shall be worn with the sides parallel to the ground and the bill facing forward at all times. A limited exception to this requirement would be during the performance of welding and/or burning operations where the hardhat design interferes with the welding/burning faceshield protection. During welding and burning activities, the hardhat manufacturer requirements must be followed to ensure proper wearing and assembly instructions are followed. Upon termination (e.g. end of shift, lunch break, job completion, etc.) of welding/burning activities, the hardhat must be immediately returned to the brim forward direction.
 - ◇ To ensure hardhat integrity is not compromised, only Company approved stickers and markings are permitted on the hardhat surface. Hardhats must never be modified by puncturing or drilling holes through the shell.
 - ◇ Periodically check the suspension on the inside of the hard hat for fraying and tears.
 - ◇ Never store items between the shell and suspension of the hard hat.
 - ◇ Exelon Nuclear Employees are required to wear hardhats whenever the potential exist for head injury due to impact and/or falling and flying objects and from limited electric shock and burn. Hard hats will be provided to Exelon employees and must meet the requirements of the American National Standards Institute (ANSI) Z89.1-1997 “Standards for Industrial Head Protection.”

- ◆ **Eye Protection** 
 - ◇ Must meet ANSI and company requirements to protect from flying particles/debris and be shatterproof. Safety glasses with side shields, safety goggles, or face shields may be needed to meet these requirements.
 - ◇ Periodically check for scratches and cracks that may obscure vision or lessen protection.

- ◆ **Hearing Protection**
 - ◇ Required for designated high noise level areas or areas where it is difficult to hear or converse.
 - ◇ Hearing protection is provided by the company.

- ◆ **Gloves** 
 - ◇ Required when there are energized electrical components, rough surfaces, possibility of slivers or cuts, chemicals or other hazards.

- ◆ **Footwear** 
 - ◇ ANSI Z41-1991 approved safety work shoes shall be worn if there is a potential for foot injury.
 - ◇ When there is less potential for foot injury, “serviceable” or a sturdy work shoe shall be worn.
 - ◇ Serviceable shoes cover the entire foot and have a sole of hard rubber or leather to prevent penetration of objects. Sandals, spiked heeled, moccasins and athletic shoes are not serviceable.

- ◇ Shoes in good condition should not have any of the following:
 - * Crushed toe guard
 - * Cracked, split or cut outer covering
 - * Cracks or holes in the soles
 - * Slick heels or soles

◆ Clothing



- ◇ Full-length trouser and a shirt covering the shoulders shall be worn while in the plant.
- ◇ Wear natural fiber or flame retardant clothing if your work exposes you to flames or electric arcs.
- ◇ Do not wear synthetic fibers because it could increase the severity of burns when exposed to enhanced heat.
- ◇ Wear long sleeves to protect your arms when working near hot pipes, equipment, or energized exposed circuits.
- ◇ Do not wear metal objects such as rings, chains and bracelets when they could be a hazard.

Refer to the ROG Specific Study Guide(s) for additional information on the use of PPE

VII. FIRE PROTECTION

State individual responsibilities regarding fire barriers such as dampers, doors, and seals

- ◆ Fire barriers are required by federal law and have been built in the plant to prevent the spread of a fire.
- ◆ These barriers come in several forms such as doors, dampers and seals.
- ◆ Fire doors should never be left open or propped open. Make sure all fire doors are firmly reclosed and latched. If a fire door is found open and cannot be closed, call the Control Room or Operations Management and report it.
- ◆ Contact the Control Room or Operations Management before beginning a task that will block open a fire door or disturb a sealed wall or floor penetration.

Refer to the ROG Specific Study Guide(s) for additional information on fire barriers

State actions an individual is required to take upon discovery of a fire

- ◆ To report a fire:
 - ◇ Notify the Control Room using the station page, radio or telephone.
 - ◇ Report the location and nature of the fire, and make sure the Control Room acknowledges the report.
- ◆ Maintain a safe distance from the fire.
- ◆ Warn others of the situation and until the fire brigade arrives.
- ◆ Never attempt to put out a fire unless you have been properly trained to do so.

Refer to the ROG Specific Study Guide(s) for additional information.



State individual responsibilities regarding the control of fire loading (wood, solvents, oil) and the disposal of flammable and combustible materials

- ◆ Regulations require that any flammable material, such as lubricants and oils, be stored in special fire cabinets.
- ◆ There are also limits on the amount of flammable materials that can be stored in any area.
- ◆ Whenever using combustible material on a job, limit the amount to just what is needed to get the work done or to the amount allowed in the area, whichever is less.
- ◆ When the job is done, return any unused combustible material to its proper storage area. If in a safety-related area, return the material to its storage area by the end of the shift unless approval has been given to temporarily store it elsewhere.
- ◆ Use of wood that is not fire retardant is not permitted on site without authorization.
- ◆ Fire-retardant wood is usually distinctively marked or stamped, most often with a color coating such as blue or green.
- ◆ Contact supervision if wood is discovered that does not appear to be fire retardant.



Refer to the ROG Specific Study for additional information on disposing of flammable materials.

State examples of the types of hot work requiring a permit

- ◆ Any work activity that has the potential of starting a fire, such as welding or grinding metal (sparks), must be approved before work is started.
- ◆ If involved in a task that could create a fire hazard and approval has not been obtained, contact supervision for guidance.

Recognize and state the response to a station fire alarm

Fire Alarm

- ◆ In the case of a fire, the station will sound the alarm or provide a station alert followed by an announcement.
- ◆ The fire brigade responds to all fires. All other personnel are expected to follow instructions provided after alarm is sounded.
- ◆ Do not use any elevator in the same building as the fire.

Carbon Dioxide (CO₂)

- ◆ CO₂ and Halon systems are examples of fire suppression systems that are intended to control and extinguish the fire.
- ◆ A local alarm warns workers that the system is about to actuate.
- ◆ If this alarms while in the room, leave immediately. Carbon Dioxide or Halon will soon fill the room and displace oxygen.

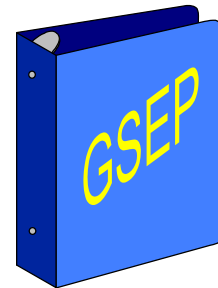


Refer to the ROG Specific Study Guide(s) for additional information.

VIII. GENERATING STATION EMERGENCY PLAN (GSEP)

State the purpose of the Generating Station Emergency Plan

- ◆ Establishes an organization and provides guidance for the safety of station personnel, property, and the general public.
- ◆ Emergencies will be declared based on station conditions and will be escalated, downgraded, or terminated as conditions change.



State the classifications of station emergencies

- ◆ Unusual Event - involves events that indicate a potential degradation of the level of safety at station.
- ◆ Alert - events in progress or have occurred that involves an actual or potential substantial degradation of level of safety of plant.
- ◆ Site Emergency - events that are in progress or have occurred that involve actual or likely major failures of plant functions needed for the protection of the public.
- ◆ General Emergency - events that are in progress or have occurred that involve substantial core degradation or melting with a potential for loss of containment integrity.

Recognize the emergency alarms and state the proper response for each

- ◆ Listen and respond to station alarms and announcements. Stay out of affected areas and proceed to designated assembly areas if required.
- ◆ If an Unusual Event is declared, not all personnel will be involved or be aware of the event. Designated individuals will be notified along with State and Local governments and the NRC.
- ◆ During an Alert Event, an announcement will be made providing you with information on any required action.
- ◆ If a Site Emergency is declared, the site emergency alarm will sound and you will be directed to report to the designated assembly area.
- ◆ If a General Emergency is declared, site and off-site emergency alarms will sound. Personnel who are not involved with emergency response will be directed to evacuate to a remote assembly area.
- ◆ Examples of emergency alarms are:
 - ◇ Reactor Building Evacuation Alarm at TMI and Oyster Creek
 - ◇ Station Emergency Alarm at Mid-Atlantic Stations
 - ◇ Assembly Alarm at Mid-West Stations except Clinton
 - ◇ General Purpose Alarm at Clinton, Peach Bottom and Limerick
 - ◇ Containment Evaluation Alarm at Clinton
 - ◇ General Evacuation Alarm at Clinton, Peach Bottom and Limerick

See the ROG Specific Study Guide(s) for additional emergency alarm information

State the actions required during GSEP implementation

- ◆ Unless you are a plant person who receives specialized training in responding to an emergency, the actions required during an emergency are as follows:
 - ◇ Listen and respond to station alarms and announcements.
 - ◇ Stay out of affected areas.
 - ◇ Proceed to designated assembly areas if required.

See the ROG Specific Study Guide(s) for additional Emergency Plan Implementation actions

State the purpose of accountability during an emergency

Assembly and accountability allows plant management to ensure that all personnel are safe and accounted for and that no one was injured by the event.

See the ROG Specific Study Guide(s) for additional information on GSEP Accountability

State the location of the employee's assigned assembly area

See the ROG Specific Study Guide(s) for site assembly areas

Discuss evacuation plans, including identification of evacuation routes

In the event of evacuation, personnel who are not part of the emergency response organization will be told the evacuation route to be taken.

State the company's policy concerning the release of information to the public and news media regarding an emergency

- ◆ If an employee is approached by the public or news media personnel, Exelon requests that they be directed to the company spokesperson. This will minimize the possibility of incorrect or untimely information.



See the ROG Specific Study Guide(s) for additional information on the release of emergency information to the public and news media

IX. Exelon QUALITY PROGRAMS

Perform the following in regards to the Quality Assurance (QA) Program:

- *State the function of the Exelon Quality Assurance program*
- *State the purpose of Nuclear Oversight (NO) assessments and surveillances*
- *State the authority of Nuclear Oversight*
- *.Identify individual responsibilities with regard to QA*

- ◆ The function of the Quality Assurance program is to provide adequate confidence that systems, structures and components will perform satisfactorily while in service. This includes:
 - ◇ Examining products, services, activities, programs and processes
 - ◇ Using a comprehensive system of NO assessments to verify compliance, evaluate effectiveness, and provide an independent check of work through observations
 - ◇ Using surveillances to observe activities, hardware and/or review of documentation to verify conformance.
- ◆ NO personnel may observe an entire job or individual steps within a job.
- ◆ NO personnel have stop work authority. This means work can be stopped for concerns regarding quality or safety.

- ◆ Workers responsibilities are:
 - ◇ Individuals are responsible for the quality of the work performed including documentation.
 - ◇ Quality products/production should be the goal of each worker and supervisor.
 - ◇ Each individual is responsible for performing the job in a quality manner and doing every job right the first time.

Perform the following in regards to the Quality Verification (QV) Program:

- ***State the function QV***
- ***State basic worker responsibilities regarding QV Verification Points and QV Hold Points***
- ***State the authority of QV Inspectors***

- ◆ Quality Verification:
 - ◇ Is responsible for performing physical inspection, examinations and measurements to verify acceptable work has been performed.
 - ◇ May observe an entire job or only a specific step.
- ◆ Verification Points or QV Hold Points:
 - ◇ Requires the individual to document compliance with the requirements prior to continuing with the task.
 - ◇ Requires QV to perform an independent inspection by observing, inspecting, or testing that point prior to proceeding further in the task.
 - ◇ Violation of a Verification Point or QV Hold Point is subject to disciplinary action.
- ◆ Quality Control personnel have stop work authority. This means they can stop work for concerns regarding quality or safety.

State the company's policy on harassment of NO personnel

Any threat, assault or interference with an inspector or assessor while performing his/her job is a federal offense punishable by a fine and/or imprisonment.

Identify potential items of non-compliance/non-conformance

- ◆ Non-conformance – something not correct with hardware, such as a part to be installed on a safety system that is not the correct part, or a safety-related valve stuck out of position.
- ◆ Non-compliance – conditions adverse to quality, such as use of an out of date procedure on a safety related task or a fire door that has been propped open to move materials from one area to another.
- ◆ Non-conforming parts may be identified by station personnel during work activities, during receipt inspection process or when documented in and NRC IE notice or bulletin.

State how to report items of non-compliance/non-conformance

- ◆ All employees have the duty to raise concerns regarding nuclear safety and quality-related issues that may affect safe operation of a nuclear plant.
- ◆ All employees have the right to raise concerns without fear of reprisal.
- ◆ A Safety Conscious Work Environment (SCWE) is an environment in which employees feel free to raise safety concerns without fear or retaliation.
- ◆ An SCWE also requires that concerns be prioritized and promptly resolved with feedback provided to the concerned employee.
- ◆ Failure to foster a SCWE discourages employees and contract personnel from reporting safety and quality concerns or issues and results in a “chilling effect.”
- ◆ A work environment in which a “chilling effect” has occurred is said to be a “Chilled Work Environment.”
- ◆ Examples of a Chilling Effect are employees that are reluctant to voice concerns for fear that they may be identified or retaliated against, employees or contractors that are discouraged from raising concerns as a result of awareness of discrimination, and management failing to act promptly to deal with acts of intimidation.
- ◆ Federal laws protect employees who are engaged in protected activities associated with identifying and reporting safety issues or concerns.
- ◆ Examples of protected activities include raising concerns to employer or regulator (e.g., NRC or OSHA), refusing to violate a NRC requirement, testifying at a NRC proceeding, or requesting the NRC to take action against an employer for a violation of NRC requirements.
- ◆ NRC penalties may include a Notice of Violation (NOV) or an order banning individual from licensed activities.
- ◆ Protection is provided against Harassment, Intimidation, Retaliation, and Discrimination (H-I-R-D).

- ◆ Energy Reorganization Act of 1974, Section 211 protects employees from retaliation and provides a personal remedy (e.g., restore job, recover lost wages, etc.). The Department of Labor (DOL) investigates complaints, holds hearings, and may order employer to remedy past actions.
- ◆ Elements that must exist in order to warrant a Section 211 complaint are that:
 - ◇ An employee was engaged in a protected activity.
 - ◇ A licensee was aware of the protected activity.
 - ◇ A licensee took adverse action against the employee.
 - ◇ There is a causal connection between the action taken and the protected activity.
- ◆ Reporting Mechanisms are First Line Supervisors, other management including Site Senior Management and Corporate Management (i.e., Chain of Command), the Corrective Action Program, Nuclear Oversight (NOS) / NOS Manager, Employee Concerns Program, or the Nuclear Regulatory Commission (NRC) – Nuclear safety or quality concerns may be reported to the NRC at any time.
- ◆ The purpose of the Employee Concerns Program (ECP) is to provide an alternate method for personnel to voice issues or concerns in regards to nuclear safety or quality that may impact the safe operation of the nuclear facilities.
- ◆ ECP investigates reports of concerns that have not been addressed when raised through the traditional methods such as through the management chain of command or through the Corrective Actions Program.
- ◆ ECP is not intended to replace the normal methods for reporting concerns or issues, but is provided for cases in which appropriate actions have not occurred.
- ◆ All other concerns or issues reported to ECP that are not relating to nuclear safety or quality are referred to the appropriate line organization for dispositioning.
- ◆ When an employee has a concern that he/she does not feel comfortable with reporting to their respective supervisor or through the normal management chain due to the sensitivity of the issue or the traditional methods have failed, the employee can contact the Employee Concerns Program.
- ◆ Confidentiality is a cornerstone of the ECP process and is maintained to the highest degree achievable in all activities and endeavors of the Employee Concerns organization.
- ◆ Extensive measures are employed in ensuring that confidentiality is always maintained by maintaining records in locked files with specific controls established for handling the documents and by maintaining, in strict confidence on a need-to-know basis only, all information relating to reported concerns or issues and all investigation activities and results.
- ◆ Employees reporting concerns to the ECP may remain anonymous, or sign a confidentiality understanding that protects their anonymity to the highest degree achievable.
- ◆ To report a concern to ECP, contact an Employee Concerns Investigator in person, via telephone, via email, or contact the Employee Concerns Hotline at 1-877-724-7783 (1-877-72-I-S-S-U-E), or e-mail the "Employee Concerns Program" in Outlook.
- ◆ Overall responsibility for the Exelon Nuclear Employee Concerns Program for the Exelon nuclear fleet resides with the Nuclear Oversight Vice President.

- ◆ Responsibility for implementation and administration of the Employee Concerns Program has been delegated to the Nuclear Oversight Programs Director. The NOS Programs Director reports directly to the NOS Vice President, thereby ensuring a totally independent reporting chain of command from the site line organizations, site management, and corporate line organizations.

Explain how to report nuclear safety concerns to the NRC

- ◆ Workers may request private interviews with the NRC Inspectors at any time. A worker who requests an inspection or reports defects is protected from discrimination. Information on workers' rights can be found in 10CFR19, posted on bulletin boards throughout the site.
- ◆ The NRC will keep the requester's identity anonymous, protect the individual from being discharged for filing the complaint and notify the individual in writing if the complaint is rejected if an inspection is requested.
- ◆ Employees are expected to be truthful and cooperative when requested for information by NRC/NO.
- ◆ Willful misconduct by any employee or contractor will not be tolerated and will result in disciplinary action, fines and/or imprisonment.

X. RADIATION PROTECTION ORIENTATION

A. INTRODUCTION

Define the terms radiation, radioactive material, contamination, and dose, and state their differences

- ◆ Radiation or radioactive decay is the term used to describe the emission of energy or particles from the atom.
- ◆ Radioactive material is any material that emits radiation as it decays.
- ◆ Contamination is radioactive material found where it is not wanted.
- ◆ Dose is the term used to describe the amount of radiation absorbed by the body or a particular organ. The unit of dose is rem or millirem (mrem).

Define background radiation and contrast the average amount of radiation received by radiation workers vs. members of the general public

- ◆ Radioactive decay is a natural process and we are continuously exposed to low levels of radiation from both natural and man-made sources. This radiation is called background radiation. The following sources contribute to background radiation:
 - ◇ terrestrial radiation from natural radioactive materials in the earth's crust, e.g., granite or coal.
 - ◇ Radon gas
 - ◇ cosmic radiation originating in space
 - ◇ potassium-40 in our own bodies
 - ◇ weapons testing fallout
 - ◇ man-made products such as medical and dental x-rays, luminous watch dials, or gas lantern mantles
- ◆ On average, a person living in the United States receives about 360 mrem per year from exposure to background radiation.
- ◆ The average nuclear power plant worker in the United States receives approximately 310 mrem per year from occupational exposure to radiation.

State the federal limit for the declared pregnant worker

A declared pregnant worker may receive 500 mrem for the entire gestation period.

See ROG Specific Study Guide(s) for additional site information

State the purpose of the thermoluminescent dosimeter (TLD), the electronic dosimeter (ED), and the whole body contamination monitor (i.e., the exit portal monitor)

- ◆ Thermoluminescent dosimeter (TLD) - a small device that is used to record the amount of radiation an individual receives while in a radiation area. The TLD result is the permanent dose record for all radiation workers on site. The TLD must be processed in order to determine the dose received by the individual.
- ◆ Electronic dosimeter (ED)- an instrument that records the amount of gamma radiation to which an individual receives when in a radiation area. The ED has a visual display that indicates the dose received. The ED also has audible alarms to alert the worker if he is approaching an RWP dose limit.
- ◆ Whole body contamination monitor - a device used when exiting a Radiological Posted /Radiologically Controlled Area.
- ◆ Portal Monitor - a device used when exiting through the gatehouse which checks personnel for radioactive contamination. Report any Nuclear Medicine treatment, such as GI, thyroid or thallium stress tests, to Radiation Protection.

Identify potential long-term effects from exposure to low levels of radiation

Research has shown that there is an increase in the potential of developing cancer from exposure to high levels of radiation exposure. As a result, scientists feel it is prudent to assume there is some risk associated with low levels of radiation. Because of this, the federal government has established limits that are low enough to minimize this risk.

Contrast the risk of working in a nuclear facility to the risk in other industries

The delayed effects of radiation exposure, such as cancer, are not a certainty but are express in terms of increased risk.

Following is a table that compares the risk of working in a nuclear facility to the risk in other industries:

Estimated Loss of Life Expectancy from Industrial/ Health Risks

Health and Safety Risk	Expectancy Loss (Average) Estimates of Days of Life
Smoking 20 cigarettes a day	6 years
Overweight (by 20%)	2 years
Alcohol consumption (U.S. average)	1 year
All accidents combined	1 year
Construction Industry	302 days
Motor vehicle accidents	207 days
Home accidents	74 days
All industrial hazards	60 days
Industrial non-radiation accidents at nuclear facilities	58 days
Occupational Radiation Exposure	
0.3 rem/y from age 18 to 65	15 days
1 rem/y from age 18 to 65	51 days
Natural background radiation	8 days
All natural hazards (earthquake, flood, etc.)	7 days
Medical radiation	6 days

State the colors and symbols used on radiological postings and identify the methods used to mark radiological areas, e.g., signs, ropes, tape

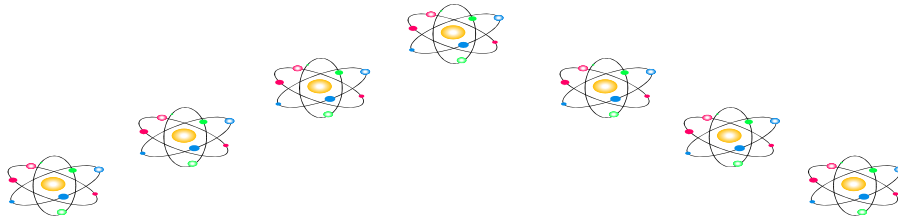
- ◆ Colors and symbols of radiological postings
 - ◇ The background of the sign is yellow.
 - ◇ The sign will have a trefoil radiation symbol on it.
 - ◇ The lettering and radiation symbols are magenta, purple, or black.

- ◆ Methods to mark radiological areas
 - ◇ Usually in the form of signs.
 - ◇ Yellow and magenta rope or tape is commonly used as part of the radiological barrier. Ropes will normally have a sign hanging from them to provide more information about the specific requirements for the enclosed area.

Refer to the ROG Specific Study Guide(s) for specific information on radiological postings

State the action(s) to be taken if a radiological area or radioactive material is encountered

- ◆ Should a radiological posting be encountered, do not enter the area or work on the equipment.
- ◆ Should radioactive material be encountered outside a radiologically posted area, immediately contact Radiation Protection. Do not touch or attempt to relocate the material. This includes tools and equipment inside the posted area.
- ◆ Do not work on any equipment with radioactive material markings or labels.
- ◆ You must successfully complete Radiation Worker Training (RWT) to enter or work in a radiologically posted area.



IX. RADIATION PROTECTION

A. SOURCES OF RADIATION

State the basic structure of an atom

- ◆ Atoms are composed of three primary components:
 - ◇ Proton - positively charged particle contained in the nucleus of an atom. The number of protons in the nucleus determine the element.
 - ◇ Neutron - neutrally charged particle also contained in the nucleus of an atom. It is approximately the same size as the proton.
 - ◇ Electron - negatively charged particle forming a cloud around the nucleus of an atom. The number of electrons in the cloud of an atom generally equal the number of protons in the nucleus. They have very little mass in comparison to the other two components of the atom.

Describe how radiation results from the nuclear process

- ◆ When an atom is unstable, it is due to the number of protons and neutrons being incorrectly balanced. It will emit packets of energy and/or particles to reach stability. It may require several emissions before becoming stable. These emissions are called radiation.
- ◆ Operation of a nuclear reactor creates unstable atoms by forcing a stable atom to accept a neutron or energized particle. The fission process, in which two or more smaller atoms are formed from splitting a larger atom, may also result in the creation of unstable atoms and the emission of radiation.
- ◆ Radiation may interact with other atoms, causing a loss of electrons. When an electron is removed, an ion pair is formed. This ion pair consists of a negatively charged electron and the remaining atom, which is positively charged since it now has more protons than electrons. This process is called ionization and can change the properties of the atom.

List the sources of radiation in the plant including the following: reactor coolant, activation and corrosion products, station components, and reactor operations

- ◆ Reactor coolant - water containing impurities that have been activated in the reactor.
- ◆ Fission and activated corrosion products - e.g., cobalt and iron that have been exposed to radiation in the reactor and have been deposited on plant components.

Just a little humor...

Two atoms are walking down the street and they run into each other. One says to the other, "Are you all right?"
 "No, I lost an electron!"
 "Are you sure?"
 "Yeah, I'm positive!"



- ◆ Reactor fuel is further activated and also releases some fission products to the reactor coolant.
- ◆ Reactor operations causes radiation.
- ◆ Filters that have had reactor coolant flowing through them.
- ◆ Reactor components that have been exposed to radiation.

Refer to the ROG Specific Study Guide(s) for additional information regarding sources of radiation

B. TYPES AND MEASUREMENT OF RADIATION

State the four types of radiation found in a commercial nuclear power plant

- Alpha**
- Beta**
- Gamma**
- Neutron**

...Some more ☺

A neutron goes into a bar and asks the bartender, "How much for a beer?"
The bartender replies, "For you, no charge!"

Characterize the four types of radiation by primary source, penetrating ability, methods of shielding, and exposure hazard

- ◆ Alpha radiation
 - ◇ Primary source is the reactor fuel and radon gas.
 - ◇ Has the least penetrating power of any of the four types identified above. Travel in a α just an inch or two.
 - ◇ Can be shielded by a sheet of paper, the dead layer of skin on the surface of the body, or by a layer of clothing.
 - ◇ Primarily an internal hazard. It may result in high dose to a sensitive organ if inhaled or ingested.

- ◆ Beta radiation
 - ◇ Primary source is activated corrosion and fission products found in fluid within piping.
 - ◇ Has more penetrating power than alpha but is limited to a few feet in air or a few layers of dead skin. Beta radiation can be shielded using plastic or aluminum.
 - ◇ Primarily a hazard to the skin or lens of the eye. Personnel must work close to a beta source to receive a significant dose. Examples of beta radiation sources include the internal surfaces of valves and pumps of the reactor coolant system.





- ◆ Gamma radiation
 - ◇ Not a particle; it is pure energy with no mass.
 - ◇ Primary sources include fission, fission products, and activation products within piping, including steam in a BWR.
 - ◇ Has great penetrating power. It can penetrate the entire body. It is best shielded by very dense material like lead, steel and concrete. Water may also be used for shielding.
 - ◇ Exposure to gamma radiation results in a whole body dose. The most common dose received at the station is a result of this type of radiation. Most radiation exposure is from activated corrosion products deposited inside piping systems.

- ◆ Neutron radiation
 - ◇ Part of the atomic nucleus that has been freed by decay or fission.
 - ◇ Primary source is nuclear fission.
 - ◇ Has great penetrating power. It is best shielded by water or concrete.
 - ◇ Exposure to neutron radiation results in a whole body dose. Most exposures to neutron radiation occur when personnel enter the containment or drywell while the reactor is operating.

Define the terms dose rate and TEDE

Dose - the amount of radiation absorbed by the body or particular organ. The unit of dose is rem or millirem (mrem). Note 1 rem = 1000 mrem

Dose rate - the amount of dose received in a specified period of time, usually one hour. The unit of dose rate is normally expressed as rem/hr or mrem/hr

If an individual spends 4 hours in a dose rate field of 15 mrem/hr, the total dose received should be dose rate field x time in field = dose: 15 mrem/hr x 4 hours = 60 mrem

Total Effective Dose Equivalent (TEDE) - the measure of an individual's total whole body dose. It is determined by adding the external dose to the internal dose and expressed in terms of rem or mrem.

Perform conversions from rem to millirem and from millirem to rem

1 rem = 1000 mrem

To convert from rem to mrem, multiply by 1,000. For example, 0.300 rem is equal to 300 mrem

To convert from mrem to rem, divide by 1,000. For example, 2,700 mrem is equal to 2.7 rem

C. BIOLOGICAL EFFECTS

State the effect of radiation on cells

- ◆ When radiation interacts with human cells, several things may happen:
 - ◇ Nothing.
 - ◇ Cells may be damaged and may repair themselves so that permanent damage is not caused.
 - ◇ Cells may die and be replaced through the normal biological processes.
 - ◇ Cells may mutate and may be repaired without effect, or they may form precancerous cells, which may become cancerous.

- ◆ Rapidly reproducing cells and organs are more likely to be affected by exposure to radiation. For this reason, an infant is more sensitive to radiation than an adult, and blood-forming cells are more sensitive than bone cells.

Define the terms and the risks associated with chronic and acute radiation exposure

- ◆ Chronic exposure usually refers to repeated exposure over a long period of time. Dose received over a day, a month, or even a year is chronic exposure. A member of the general public receives about 360 millirem per year of chronic radiation exposure.
 - ◇ Scientific studies show that there may be an increased chance of developing health effects such as cancer from chronic exposure to low levels of radiation.

- ◆ Acute exposure usually refers to a large dose of radiation received in a short period of time, usually less than 24 hours.
 - ◇ Assuming whole body exposure, exposure to entire population and no medical treatment, the risks effects depending on the dose is as follows for acute exposure:
 - 0 - 25 rem**.....No observable effects
 - 25 - 100 rem**.....Slight blood changes, no other observable effects
 - 100 - 200 rem**..... Vomiting may occur within 3 hours of exposure. Moderate blood changes are possible. Except for the blood-forming system, recovery will occur in essentially all cases within a few weeks.
 - 200 - 600 rem**..... Vomiting for most people occurs within 3 hours. Loss of hair after 2 weeks, severe blood changes, hemorrhaging, and infection. Death may occur. The recovery period is one month to one year.
 - Over 600 rem**..... Vomiting occurs within one hour. Other effects include severe blood changes, hemorrhage, infection, and hair loss. Probability of death is at least 80% within two months. Survivors convalesce over a long period of time.

Define “somatic” and “genetic” effects and compare the health effects associated with each

- ◆ Somatic effects occur in the individual that has received the radiation exposure. They are broken into two groups:
 - ◇ Prompt or early effects appear shortly after the exposure (immediately or up to a few months post exposure). Prompt effects are generally considered the result of a large acute exposure. Some of the known prompt effects are skin reddening or nausea.
 - ◇ Delayed effects occur months or years following an exposure. Delayed effects may result from acute or chronic exposure. Some of the known delayed effects of radiation are cancer and cataracts.
- ◆ Genetic effects appear in future generations of an individual who received the radiation dose. Genetic effects cause damage to genetic material and may appear as birth defects or other conditions in the future children of an exposed individual and succeeding generations. Studies have shown that the risk of genetic effects is very small.

Identify the possible effects of radiation on an unborn child due to prenatal exposure

- ◆ The embryo/fetus is believed to be more sensitive to radiation damage than adults since it is rapidly developing. If the embryo/fetus is exposed to radiation, abnormal effects may be observed in the child after birth. These effects may slightly increase the chances of mental retardation, abnormal growth, structural abnormalities, or death.
- ◆ Due to the unborn child’s increased sensitivity to radiation, regulations impose stricter dose limits on the pregnant female who voluntarily notifies management of her condition.
- ◆ Refer to Exelon procedure RP-AA-270 for complete details regarding Exelon’s Fetal Protection/Post-natal Program.

Compare the radiosensitivity of different age groups

Radiation has a greater effect on cells that have a higher rate of reproduction. As a person ages, most cell reproduction rates slow. Therefore, the effects of ionizing radiation on the body lessen as an individual grows older.

State the purposes of the NRC Form-4

- ◆ All previous occupational doses of non-medical radiation dose must be recorded on an NRC Form-4.
- ◆ A completed and signed NRC Form-4 must be on record before you will be allowed to work as a radiation worker.
- ◆ It is your responsibility to ensure all exposure is reported to the company prior to starting work in the plant.

For NRC Form-4, see Attachment E

D. LIMITS and GUIDELINES

State the federal radiation dose limits for total effective dose equivalent (TEDE), shallow dose equivalent (SDE), extremities, and lens of the eye (LDE)

- ◆ Radiation dose limits are set by the federal government. The Nuclear Regulatory Commission (NRC) establishes the legal limits based on the present understanding of the biological effects from radiation.
- ◆ The limits are set low enough to prevent prompt effects, to minimize delayed effects, and to ensure that risks due to radiation exposure are comparable with other industries.
- ◆ Since effects of radiation on some body parts are different than other body parts, the limits for radiation exposure are established based on biological radiation sensitivity.
- ◆ The code of federal regulations, 10 CFR 20 states that no licensee shall allow any individual to receive a total occupational radiation dose in excess of the following values:
 - ◇ 5 rem TEDE per year of total whole body (head and trunk, active blood-forming organs and gonads)
 - ◇ 50 rem per year shallow dose equivalent (SDE) to the skin of the whole body
 - ◇ 50 rem per year to any internal organ
 - ◇ 50 rem per year to the extremities (elbows, lower arms, wrists, hands, knees, lower legs, ankles, and feet)
 - ◇ 15 rem per year to the lens of the eye (LDE)
 - ◇ 500 millirem per pregnancy term
 - ◇ 100 millirem per year to members of the public that are part of the general population

State the possible consequences if any federal radiation dose limit is exceeded

- ◆ Depending on the nature and severity of the event, one or more of the following consequences may occur:
 - ◇ Increased risk of adverse health effects
 - ◇ NRC fine
 - ◇ NRC action against the plant and/or individual
 - ◇ Possible disciplinary action for willful violation, e.g., suspension of access to RPA. Workers have the responsibility to keep their dose ALARA.

State the plant administrative exposure control levels/guidelines for radiation dose

Administrative dose guidelines have been established to provide an added measure or protection for station workers. These guidelines will help reduce the potential of a worker exceeding the federal limits.

For site administrative guidelines, see ROG Specific Study Guide(s)

State the actions to be taken if administrative exposure control levels are being approached

If an administrative exposure control level is being approached, it is possible to increase the allowed dose, but only with prior authorization for additional exposure before the exposure level is exceeded.

See ROG Specific Study Guide(s) for additional information on increasing authorized dose levels

NOTE

Exceeding the administrative exposure control level may be reportable to the NRC.

State the federal limit and plant administrative control levels/guidelines for an embryo/fetus and the rights of a declared pregnant female

- ◆ Regulations dictate a dose limit of 500 mrem for the entire term of a pregnancy of a declared pregnant worker with a precaution to minimize and evenly spread out the dose received throughout the pregnancy.

For site administrative guidelines, see ROG Specific Study Guide(s)

- ◆ The above controls will be applied only to women who voluntarily declare their pregnancy. This declaration must be made in writing. It is voluntary and may be withdrawn at any time for any reason. The withdrawal must also be submitted in writing.

- ◆ Once a declaration of pregnancy is received, the worker will have the option of working in radiation areas with her dose restricted, or she may request reassignment to a location which has little or no radiation dose.

Recognize the definition of a planned special exposure

- ◆ Planned special exposure
 - ◇ An infrequent exposure to radiation separate from, and in addition to, the annual federal dose limits
 - ◇ May be used only in an exceptional situation where alternatives that might avoid the higher exposure are unavailable or impractical.
 - ◇ Using a special exposure involves potentially allowing a worker to exceed a federal dose limit, and special controls and management permission is necessary before this exposure would be allowed.

E. As Low As Reasonably Achievable (ALARA)

ALARA

State the purpose for ALARA

The basic purpose of ALARA is to:

- ◆ To keep the radiation dose to both an individual and the group involved with the task performance as low as reasonably achievable while still completing the task in an efficient manner.
- ◆ Each nuclear station provides radiation protection procedures and policies to help keep your radiation exposure As Low As Reasonably Achievable (ALARA).
- ◆ ALARA is an acronym, meaning As Low As Reasonably Achievable. This practice is used to minimize internal dose as well as external dose.

Describe a typical station ALARA program

A formal ALARA program represents a management commitment to minimize personnel dose. This program will help ensure that ALARA concerns and suggestions are addressed and also helps to educate workers of daily dose reduction controls. The ALARA program consists of:

- ◆ For an effective ALARA program, policies and procedures have been established.
 - ◇ Pre-job briefings include active participation by RP/Rad Con personnel who may provide job coverage and address any problem areas in the task performance, alternatives and RP impact.
 - ◇ The pre-job briefing is to ensure workers are aware of the dose rates and conditions in the work area. Briefings may be obtained from the RP desk, ALARA pre-job brief or RP will provide information during an Ops Shift brief.
 - ◇ Job planning, use of mock-ups during training, dose reduction techniques, and engineering controls.

- ◆ The **individual worker** bears primary responsibility for maintaining his/her exposure ALARA during daily work activities. Workers must be alert to changing radiological conditions due to radiography, reactor power levels, and system lineups.

For site information on the ALARA Program, see ROG Specific Study Guide(s)

Explain how time, distance and shielding may be used to reduce dose and methods to implement these concepts and responsibilities toward temporary shielding

- ◆ Time
 - ◇ The longer a worker remains in an area that contains dose rate fields, the more dose the worker will receive.
 - ◇ Radiation dose increases with an increase in time spent in radiation fields.
 - ◇ **Minimize** time in areas that contain dose rate fields.
 - ◇ Try to completely understand all aspects of the work activity before you enter the radiation area. This includes taking the right tools, prefabrication when possible, correct spare parts, and knowing the exact location of the equipment.
- ◆ Distance
 - ◇ The farther away a worker is from the source of radiation, the less dose the worker will receive.
 - ◇ Radiation field strength diminishes as distance increases from the source of radiation.
 - ◇ **Maximize** your distance from radiation sources.
 - ◇ Dose can also be reduced by using long handled tools, video cameras, and other devices which allow the worker to stay away from the radiation source.
- ◆ Shielding
 - ◇ The application of an effective shield over a radiation source, the less dose the worker will receive.
 - ◇ Radiation field strength diminishes as you place shielding over the source of the radiation, but prior approval must be obtained before shielding can be placed on equipment or piping.
 - ◇ In nuclear power plants, the most common form of shielding is lead blankets.
 - ◇ **Maximize** the use of shielding.
- Temporary shielding
 - A total dose savings must be realized for temporary shielding to be used.
 - Tampering with installed shielding could drastically change the dose rates in the area.
 - Contact RP/Rad Con if shielding is blocking equipment you are required to work on

DO NOT MOVE OR REMOVE ANY TYPE OF SHIELDING WITHOUT SPECIFIC AUTHORIZATION FROM RADIATION PROTECTION!

For site guidelines on shielding, see ROG Specific Study Guide(s)

Calculate a stay time given a dose rate, current exposure, and an exposure control level

Worker is approved to 100 millirem for the day

Digital dosimeter is set to alarm at 80 millirem

Dose rate in the work area is 40 millirem/hr

Worker has 0 millirem so far for the day

How long can the worker work in the work area until the dosimeter alarms? **2 hours**

$$\text{STAY TIME} = \frac{\text{DOSE LIMIT} - \text{CURRENT DOSE}}{\text{DOSE RATE IN WORK AREA}}$$

F. RADIATION DOSIMETRY

State the purpose of dosimetry

- ◆ Dosimetry accurately measures external radiation dose absorbed by personnel.
- ◆ Dosimetry for personnel monitoring is important to ensure workers are within exposure control levels.

List the types of radiation detected by the TLD and ED/DRD

- ◆ Thermoluminescent Dosimeter (TLD) - Primary
 - ◇ Measures external exposure to personnel.
 - ◇ Does not provide real-time dose information; must be “processed” at a later time.
 - ◇ Used for the permanent occupational external dose record.
 - ◇ Detects and measures dose from beta, gamma and neutron radiation. Skin and lens of eye dose can also be assessed.
- ◆ Electronic Dosimeters (EDs) or Direct Reading Dosimeters (DRDs) – Secondary
 - ◇ Worn in close proximity to TLD; provides a real-time estimate of dose received while on the job.
 - ◇ Provides general area dose rate information.
 - ◇ Has various alarms that activate if some preset conditions are exceeded.
 - ◇ Designed to measure gamma radiation only.
- Pocket Ion Chambers
 - Worn in close proximity to TLD; provides a real-time estimate of dose received while on the job.
 - Designed to measure gamma radiation
 - Used if ED/DRDs are not readily available and do not have alarm capability

Identify how to wear dosimetry devices properly including placement and orientation

- ◆ TLDs and EDs should be worn on the front of the body between the waist and shoulders, unless otherwise specified on the RWP.
- ◆ TLD beta window should face away from the body and be located next to the ED or Pocket Ion Chamber if used.
- ◆ Additional or special dosimeters may be required for certain jobs where the dose rates to areas of the body may be higher than those to the chest region (i.e., when work is being performed in non-uniform dose rate fields where worker to source orientation is subject to change).
- ◆ For multiple whole body and extremity placements, the most conservative reading will be your legal dose record.

For site guidelines on dosimetry placement, see ROG Specific Study Guide(s)

Identify the modes, methods, and frequency for operating and reading dosimetry

- ◆ TLDs:
 - ◇ Should be handled with care and do not tamper with the TLD case.
 - ◇ Do not display dose information, they must be processed through the use of a special TLD reader and associated computer software.

- ◆ EDs:
 - ◇ Two modes of operation: accumulated dose mode and dose rate mode.
 - ◇ Each mode has an active preset alarm that will sound when thresholds have been exceeded.
 - ◇ Accumulated Dose Mode provides a readout of estimated dose in units of mrem. Verify ED/DRD display indicates 0 mrem after activation. If not, return the ED.
 - ◇ Dose Rate Alarm is activated when your dose rate is greater than the preset allowable dose rate.
 - ◇ Should never be used by personnel as a hand held dose rate meter.
 - ◇ Alarm thresholds set via computer to values specified by the RWP.
 - ◇ The ED should be worn next to the TLD to ensure consistent personnel dose measurement.

Look at your ED frequently, especially in high noise areas or if the ED is wrapped in plastic. Industry experience has shown that work in these types of areas has resulted in unplanned radiation dose when the worker could not hear the appropriate radiation dose alarms.

- The pocket ion chamber is read by looking through the barrel while pointing the PIC at a light source. High humidity and shocks, such as dropping, will affect the PIC's accuracy.

For further information on dosimeters, see ROG Specific Study Guide(s)

Identify where and when TLDs and ED/DRDs are issued and returned

- ◆ TLDs
 - ◇ Shall be stored with the security badge or key card when not in use.
 - ◇ Wear TLD at all times while on site.
 - ◇ Do not wear your TLD at another nuclear facility.
- ◆ ED/DRDs
 - ◇ Individuals are to obtain their ED/DRD before entering the RPA/RCA. The ED/DRD must be “logged in” and activated by a computerized access control system prior to entering the RPA/RCA.
 - ◇ Individuals are to return their ED/DRD when exiting the RPA/RCA where the dosimeter must be “logged out” by the computerized access control system.

For site guidelines on issuing and returning dosimetry, see ROG Specific Study Guide(s)

State the action(s) to be taken if dosimetry is lost, damaged, off-scale or alarming

- ◆ Lost, damaged or missing: place your job in a safe condition, immediately leave the RPA/RCA, and report to RP/Rad Con.
- ◆ Alarming ED: immediately notify your co-workers, leave the RPA/RCA and notify RP/Rad Con.
- ◆ Dosimetry not working correctly: leave the RPA/RCA and return the dosimeter to RP/Rad Con.

CAUTION



Caution should be used if you are using a portable radio and an ED. Some radio antennas can interfere with the operation of the ED. Keep the radio and the antenna at least 4 inches from your ED. If you have any questions or concerns, check with RP/Rad Con supervision before you enter the RPA/RCA.



For site information on response to abnormal dosimetry conditions, see ROG Specific Study Guide(s)

G. CONTAMINATION

Remember contamination is radioactive material in an unwanted area. Contamination could be classified as fixed, loose, or airborne. The two major sources of contamination are fission products and activated corrosion and wear products. In some cases contamination may also include hot particles.

A surface may be contaminated by a water spill, the settling of radioactive dust, or from maintenance on a radioactive system.

Identify the types of contamination found in nuclear power plants and why it is controlled

The main types of contamination found in nuclear power plants:

- ◆ “Fixed” contamination
 - ◇ Contamination that has become firmly embedded in an object and cannot be removed using normal cleaning methods.
 - ◇ Could become airborne or spread through activities such as grinding or welding. Fixed contamination can leach out of porous surfaces of tools and equipment and become loose or airborne at that point.
- ◆ Loose surface contamination
 - ◇ Contamination that is loosely attached to the objects it settles on and can be easily removed. Sometimes referred to as “smearable.”
 - ◇ Loose contamination can easily be detected by wiping a cloth smear over the material surface and monitoring the smear for contamination.
 - ◇ High levels of loose contamination can easily become airborne if disturbed or transfer from equipment to personnel.
 - ◇ Ventilation changes and personnel traveling through the area can result in contamination movement.
- ◆ “Discrete” or “hot” particles
 - ◇ Very small radioactive particles that may be too small to be seen
 - ◇ Can be highly radioactive and deliver a large localized dose
 - ◇ A hot particle can cause a large dose to internal organs if ingested

For site guidelines on types of and controlling contamination, see ROG Specific Study Guide(s)

State contamination units, identify sources, and potential indications

Contaminated Area – An area within an RPA that requires protective clothing due to presence of smearable contamination.

Since contamination is radioactive material, it is measured by the level of activity. Contamination is often measured by wiping a cloth smear over an area and monitoring the smear with a detector. A frisker is often used for this purpose.

The units for contamination are counts per minute (cpm) or disintegrations per minute (dpm) per unit area. This is typically dpm/100 cm².



- ◆ Potential sources of contamination include:
 - ◇ Spills and leaks from a system carrying contaminated water
 - ◇ Open contaminated systems
 - ◇ Grinding on equipment with fixed contamination
 - ◇ Disassembly of a station component with internal contamination

- ◆ Potential indications of contamination include:
 - ◇ Reactor water is leaking from a pipe, pump, or valve
 - ◇ A pipe or valve is being removed from a potentially contaminated system
 - ◇ Maintenance is being performed on a potentially contaminated component or system
 - ◇ Water is on the floor near or under a contaminated system
 - ◇ A rise in frisker counts or a frisker alarm

- ◆ Always use care around potentially contaminated systems because you may contaminate yourself or spread contamination around the plant.

Identify methods to prevent the spread of contamination

- ◆ Methods that are effective in preventing the spread of contamination include:
 - ◇ Planning a job and use of pre-job briefings.
 - ◇ Using protective clothing (PCs) when working in a contaminated area.
 - ◇ Avoiding water that is around or under a contaminated system.
 - ◇ Securing hoses or cords that extend from a non-contaminated area to a contaminated area
 - ◇ Using of catch containments, glove bags, or absorbent material.
 - ◇ The use of step-off-pads and warning signs.
 - ◇ Decontamination of surfaces and components prior to start of work AND after work is complete.
 - ◇ Restricting entry to contaminated areas or potentially contaminated areas that are not routinely monitored for contamination.
 - ◇ Use of engineering controls such as temporary ventilation, HEPA air filters and vacuum cleaners, and use of specially designed enclosures.
 - ◇ Keeping the workplace clean.

Discuss actions for removing material from the RPA/RCA or Contaminated Area

- ◆ All material must be checked for contamination before removal from the RPA/RCA.
- ◆ A hand-held frisker and the Small Articles Monitor (SAM) are examples of devices used to survey items out of the RPA/RCA.

For further information on removing material from the RPA/RCA or Contaminated areas, see ROG Specific Study Guide(s)

Explain how to monitor personnel and personal items for contamination and actions to take if contamination is indicated

- ◆ Primary methods to monitor personal contamination are the frisker and the personal contamination monitor (PCM).
- ◆ The frisker is a hand-held probe that indicates contamination in units of counts per minute (cpm).
- ◆ Perform the following to use a frisker:
 - ◇ Verify the frisker is on, set the scale to the times on (X1) scale, turn volume up and verify calibration sticker and daily source check is current.
 - ◇ Check background radiation. If greater than 300cpm, use another frisker or contact RP/Rad Con.
 - ◇ Frisk hands prior to handling probe, at 2 inches per second no more than ½ inch away from probe.
 - ◇ Frisk hand-held items.
 - ◇ Frisk rest of body as instructed by step-off pad.
- ◆ Re-monitor if the frisker indicates an increase in counts. Remain in the area and contact RP/Rad Con if contamination is verified or suspected.
- ◆ To use a PCM, enter and follow instructions provided. If the monitor does not alarm, exit the monitor and proceed as normal. If the monitor alarms:
 - ◇ Re-monitor – if second alarm is received, remain in the area, minimize contact with personnel or tools or equipment and contact RP/Rad Con.

For additional information, see ROG Specific Study Guide(s)

State the method for control of contaminated tools, equipment and materials

◆ **Control of Contaminated Materials**

- ◇ While working on contaminated systems or equipment, it is likely that tools and materials used during the task will become contaminated. Company policy requires that you minimize the contamination of these items. Actions that can be taken by workers to reduce the contamination include:
 - * Minimize the amount of material taken into the contaminated area to just those actually needed.
 - * Keep packing material to the bare minimum necessary to reduce the amount of radwaste generated.
 - * Get tools from the hot tool room and if possible, use contaminated tools for work in highly contaminated areas.
 - * Treat all floor drains in the RPA as internally contaminated. Contact RP/Rad Con prior to working with or removing anything from a floor drain.
 - * If a contaminated article needs to be removed from a contaminated area, it should be bagged and clearly labeled by RP/Rad Con.

All personnel must report leaks as soon as they noticed. Upon identification, a catch containment should be installed to reduce the potential spread of contamination.

State the methods to designate contaminated areas including posting and step-off pads

◆ **Contaminated Area Posting**

- ◇ You can be aware of known contaminated areas by the presence of radiation barrier ropes, step-off pads, and warning signs. Warning signs include **Contamination Area** and **High Contamination Area**. Do not enter the area or reach over ropes unless authorized.

NOTE

Overhead areas are not routinely surveyed and in many cases are contaminated. Workers can not access overhead areas without informing RP/Rad Con. Surveys must be performed and proper controls must be established before accessing overhead areas.

- * **Contamination Area** is an area with smearable contamination $\geq 1,000$ dpm/100 cm. sq. beta-gamma contamination. Entry into this area requires an RWP to ensure proper protective clothing is being worn for the work activity. The sign should state “Caution Contaminated Area.”
- * **High Contamination Area** is an area with smearable contamination $\geq 100,000$ dpm/100 cm. sq. beta-gamma contamination. Entry into this area requires an RWP to ensure proper protective clothing and radiological controls are used to prevent the spread of contamination. The posting should state “Caution High Contamination Area.”

Refer to the ROG Specific Study Guide(s) for site specific alpha contamination limits

State hazards, methods to identify hot particles, sources, work activities and precautions to be used regarding discrete/hot particles

- * **Hot Particles** are very small but can deliver a large localized dose. Hot Particle areas often have a double step-off pad, additional plastic sheeting barriers or other controls to reduce the potential for particle movement. Hot particles can originate from nuclear fuel or from corrosion product material. In either case, the particle is highly radioactive and can deposit a relatively high dose to a small area of the skin or tissue.
- * When frisking, a hot particle can cause the meter to rapidly rise.
- * Some precautions that should be used in areas that may contain hot particles are careful review of the RWP survey map for hot particle contamination areas, use of protective clothing as required by the RWP, and careful monitoring for hot particles when exiting the area.

Identify situations that require personnel to exit a contaminated area

If any of the following occur, immediately leave the area:

- ◆ As directed by RP/Rad Con personnel
- ◆ As directed by assembly sirens and announcements from the Control Room
- ◆ Failure, rips, or deterioration of protective clothing or equipment
- ◆ Unexpected deterioration of radiological conditions in the work area, unexpected water, powder or dust, or loss of contamination control ventilation
- ◆ Injury such as cuts, abrasions, or any other type of wound
- ◆ PCs become wet from a leak or spill
- ◆ Lost or damaged dosimetry

H. INTERNAL EXPOSURE

State four pathways for radioactive material to enter the body

- ◆ **Inhalation**—(breathing it in) Inhalation is the most common way of receiving internal dose.
- ◆ **Ingestion**—(eating, drinking, chewing or swallowing) Ingestion of radioactive material could occur from eating with contaminated hands or if your face becomes contaminated.
- ◆ **Absorption**—(absorbing it through the skin) Skin absorption applies to certain nuclides such as tritium, sodium, and iodine. The contaminated material is dissolved in water. The water is splashed on the skin allowing contamination into the body.

- ◆ **Open wounds**—(entering through an open wound or sore) Contamination can be admitted to the body when contamination contacts the skin around an open wound or broken skin.

State the methods used to limit the internal deposition of radioactive materials including respiratory protection and engineering controls

- ◆ No eating, drinking, smoking, or chewing within the RPA/RCA reduces the potential for radioactive material entering the body from these processes.
- ◆ Engineering and workplace controls.
 - ◇ Decontamination of the area or equipment
 - ◇ Installation of ventilation systems with temporary filters, commonly known as HEPA filters.
 - ◇ Isolation of potentially radioactive steam leaks.
 - ◇ Using contamination control tents, glove bags, or enclosures
 - ◇ Use of special HEPA vacuum cleaners
 - ◇ Shifting ventilation flowpaths.
- ◆ Use of respirators/other protective equipment.
 - ◇ Limiting the amount of time spent in an airborne area

State the processes by which radioactive material is eliminated from the body

- ◆ Biological Processes
Radioactive material can be eliminated from the body by the following processes:
 - ◇ Urinary excretion
 - ◇ Fecal Excretion
 - ◇ Perspiration
- ◆ Radioactive Decay lowers the amount of radioactivity in the body as time passes. The amount of time required for a radionuclide to decay is dependent on the isotope and can vary from seconds to many years (this is called radiological half-life).

Recognize the methods used to determine the amount of radioactive material deposited in the body, including whole body counters and bioassays

- ◆ Whole Body Counter: A gamma monitoring device used to directly measure and identify the radioactive material deposited in or on the body.
- ◆ Bioassays: A laboratory evaluation of biological material (usually a urine or fecal sample) for purposes of estimating the quantity and location of radioactive material in the body.
- ◆ Whole Body Screen/Passive Monitoring: A simple survey of workers to evaluate the presence of significant internal radioactivity.

Define Committed Effective Dose Equivalent (CEDE), Annual limit on Intake (ALI), Derived Air Concentration (DAC)

- ◆ Committed Effective Dose Equivalent (CEDE)-the amount of assigned internal dose that relates organ dose to the whole body dose.
- ◆ Annual Limit on Intake (ALI)-the amount of airborne radioactive material you would have to breath in to receive a CEDE of 5 rem effective dose equivalent or 50 rem to any organ. Each individual is limited to 1 ALI per year.
- ◆ Derived Air Concentration (DAC)-the concentration of a radioactive material in air which would result in a volume (and equivalent dose) of 1 ALI per year if breathed for 2000 hours.

State the relationship among DACs, ALIs, CEDE and TEDE (DAC and mrem/hr relationship)

- ◆ 2000 DAC-hours represents one ALI, equivalent to a Committed Effective Dose Equivalent (CEDE) of 5 rems.
- ◆ 5 rems internal exposure (CEDE) is equivalent to 2000 DAC-hrs., therefore, 1 DAC-hr. is equivalent to 2.5 mrem (5000 mrem/2000 DAC-hr.=2.5 mrem/DAC-hr.).
- ◆ Total Effective Dose Equivalent (TEDE) is the sum of the internal dose (CEDE) and external dose (Deep Dose Equivalent (DDE)).

Discuss plant conditions that may increase the potential for airborne radioactivity

- ◆ Brushing or sweeping
- ◆ Fans blowing in dusty areas
- ◆ Improper use of vacuum cleaners or using the unfiltered vacuums in contaminated areas
- ◆ Breaching contaminated systems
- ◆ Steam leaks
- ◆ Sanding, grinding, burning, or welding on a contaminated pipe, valve, or equipment
- ◆ Wet contaminated area that is drying out

Be alert to the types of conditions that can increase the airborne activity levels and your total dose (TEDE).

I. RWP

State the function of a Radiation Work Permit (RWP)

- ◆ Authorizes individuals to enter radiologically posted areas.
- ◆ Provides the radiological requirements necessary for you to work in the area including protective clothing, equipment required, special procedures, and precautions to be followed.
- ◆ Provides information regarding the radiological conditions and hazards in your work area.

State the types of RWPs and the function of each

- ◆ RWPs utilized for repetitive, general or routine work may be referred to as:
 - ◇ Standing RWP – Limerick/Peach Bottom
 - ◇ General RWP – Braidwood/Byron/Dresden/Lasalle/Quad Cities
 - ◇ Blanket RWP – TMI/Oyster Creek
 - ◇ Departmental Generic RWP – Clinton
 - ◇ Area Access RWP - Clinton
- ◆ Job Specific or Specific RWP - for work which may not be of a routine nature and could change radiological conditions in your work area or another location in the plant.

Extract information from an RWP (for example protective clothing, dosimetry, special instructions)

The RWP contains the following information:

- ◆ **RWP Number:** Unique number for documentation and tracking purposes.
- ◆ **Location:** Locations that are covered by this RWP by Unit, Building, Elevation, Room/Area.
- ◆ **Description of Work:** Brief description of the work that is approved when working under this RWP.
- ◆ **Exposure Monitoring Required:** Dosimetry needed to safely complete this task (e.g. TLD, Extremity dosimetry, Electronic dosimetry, Neutron dosimetry, Multiple dosimetry, etc.).
- ◆ **Protective Clothing:** Clothing needed to perform the task or portions of the task.
- ◆ **Respiratory Protection Required:** Respiratory protection needed to perform the task or portions of the task.
- ◆ **Special Instructions:** Special requirements or hold points will be explained in this section.
- ◆ **ED Settings:** Allowed dose and dose field alarms. The ED alarm settings are automatically set for you when you process into the access computer.

State the responsibility for complying with RWP requirements

You must read, understand and comply with all aspects of the RWP under which your job is conducted. The RWP requirements are placed in the RWP to protect the workers while they perform functions or tasks. You are expected by your managers and supervisors to be in full compliance with the RWP requirements at all times. Non-compliance with RWP requirements may result in a radiological event, increased dose, spread of contamination or other radiological concern. Non-compliance could result in increased regulatory action and disciplinary action.

Refer to the ROG Specific Study Guide(s) for site specific information regarding RWP compliance

Extract information from a survey map


Survey maps generally show a drawing of the work area and/or components/equipment the worker requires access to as covered by the RWP. Information found on the survey maps include:

- ◆ Levels of contamination - Contamination levels are measured in units of disintegrations per minute/100 centimeters squared (dpm/100cm²)
- ◆ Dose rates - in mrem or Rem per hour, (mr/hr or R/hr) taken at chest level unless indicated otherwise
- ◆ Low Dose waiting areas
- ◆ Radiological Postings
- ◆ RWP number for which the survey was performed
- ◆ Date that the survey was performed
- ◆ Location of area or component to be worked
- ◆ Legends (normally provided) distinguish different symbols used on the map

State the required action(s) to be taken if the work scope or radiological conditions change so that they are not within the scope of the RWP

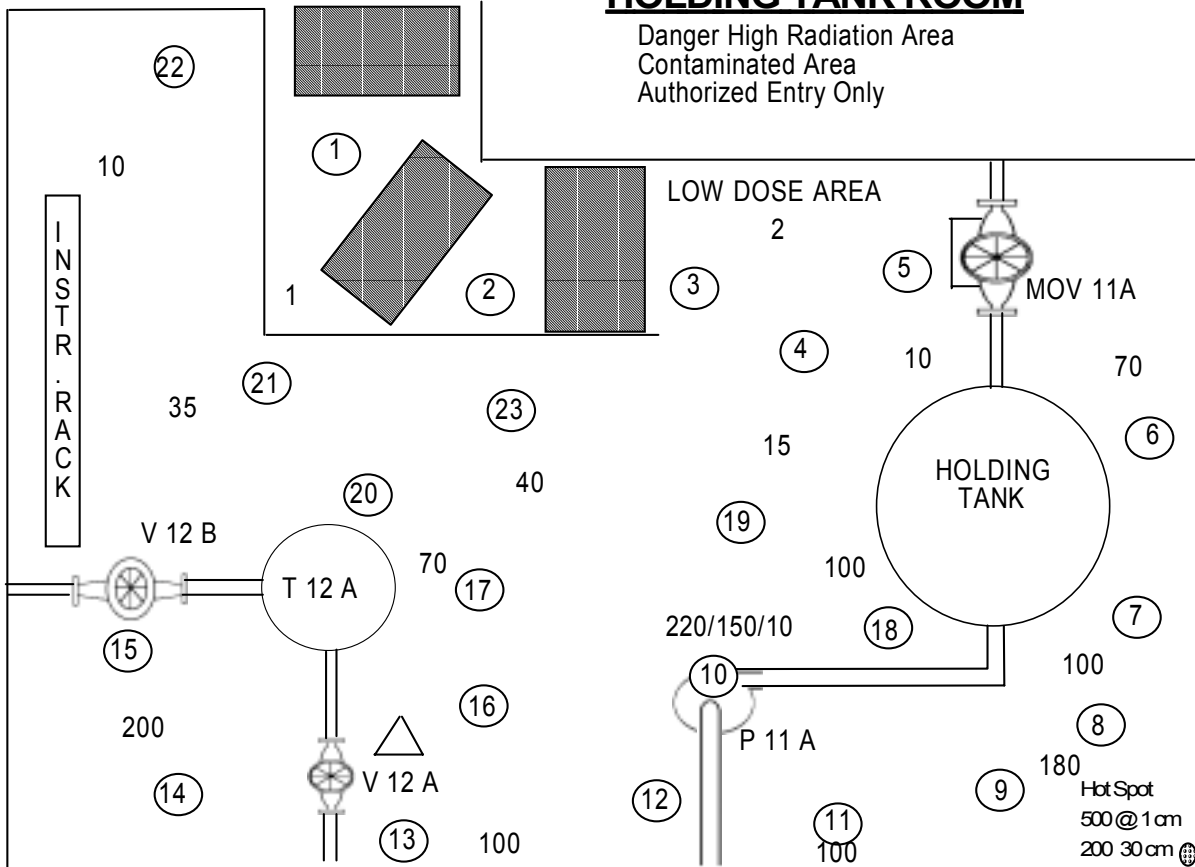
- ◆ If you discover that the radiological conditions are different than expected, or if the conditions change unexpectedly, inform others that may be affected to exit the area, and contact RP.

- ◆ If, while working on a task in the RPA/RCA, the scope of the job changes, contact RP/RadCon before proceeding. This could include:
 - ◇ moving of component not originally planned.
 - ◇ opening of a contaminated system.
 - ◇ movement of shielding.
 - ◇ removal of internal components.
 - ◇ spill of contaminated fluids.

A large, yellow, 3D-style letter 'R' with a black outline and a grey shadow cast to the left and slightly forward.A large, yellow, 3D-style letter 'W' with a black outline and a grey shadow cast to the left and slightly forward.A large, yellow, 3D-style letter 'P' with a black outline and a grey shadow cast to the left and slightly forward.

HOLDING TANK ROOM

Danger High Radiation Area
Contaminated Area
Authorized Entry Only



- △ = Air Sample Location
- # = Smear Location
- # = Gamma
- = Sign Postings
- (L) = Large Area Smears
- = Step Off Pads

Dose Rate and Contamination Survey

Date Yesterday

Time 12:00

Inst Used Serial #

CP 23

GM 10

Air Sampler 43

RWP Number 950001 Rev 00

NOTE : All dose rates are in mrem/hr unless otherwise noted . All dose rates at chest level unless otherwise noted .

Reviewed by : _____ Date ; _____

dpm / 100 cm²

1	NCF	13	18K
2	NCF	14	15K
3	1K	15	17K
4	2K	16	21K
5	2K	17	20K
6	7K	18	15K
7	10K	19	12K
8	12K	20	10K
9	15K	21	8K
10	30K	22	7K
11	58K	23	10K
12	18K		

SURVEY LEGEND

#	GAMMA DOSE RATES
##/##	DOSE RATE AT CONTACT / 30 cm / 1 METER
# @ 1	DOSE RATE AT ONE FOOT
#N	NEUTRON DOSE RATE
#B	BETA DOSE RATE (in MRAD/HR)
NBD	NO BETA DETECTED
Hd	HEAD
Ch	CHEST
Ak	ANKLE
WB	WHOLE BODY
C	CONTACT
#	SMEAR LOCATION
<	LESS THAN
>	GREATER THAN
K	1000
DPM	DISINTEGRATIONS PER MINUTE
(#K)	LEVEL OF CONTAMINATION
NCF	NO CONTAMINATION FOUND
DAC	DERIVED AIR CONCENTRATION
Δ	AIR SAMPLE LOCATION
—	RADIATION AREA BOUNDARIES
A, B	POSTING A, POSTING B

All dose rates are in mrem/hour unless otherwise noted.
 All dose rates are at chest level unless otherwise noted.
 Smears are NUCON smears (100 cm²) in contaminated areas.
 Smears are (L) in clean areas or to release contaminated areas.

J. POSTINGS

Define and recognize radiological areas and postings

◆ **Restricted Area** - an area with limited access to protect individuals from exposure to radiation and/or radioactive material.

◆ **Radiation Area** - an area with a dose rate greater than 5 but less than 100 millirem per hour at 30 cm from the source of radiation. →

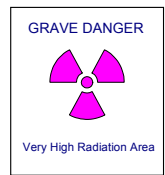


◆ **High Radiation Area** - an area with a dose rate greater than 100 millirem and less than 1,000 millirem per hour at 30 cm from the source of radiation. Barricades/Barriers for HRAs shall NOT be left open or defeated. Only RP personnel are authorized to change the position of radiological boundaries. An ALARA brief is required prior to entering this type of area. →



◆ **Locked High Radiation Area** - an area where you can receive greater than 1,000 millirem per hour in the general area. The access is locked due to the high dose rates.

◆ **Very High Radiation Area** - an area that has dose rates greater than 500 rads per hour at 1 meter from the source of radiation. This is the only posting that uses the words, "Grave Danger." →



◆ **Airborne Radioactivity Area** - an area containing airborne radioactivity that exceeds 0.30 DAC or 30% of a DAC.

◆ **Radioactive Materials (RAM)** - an area where radioactive material may be found in excess of 10CFR20 limits. →



◆ **Radioactive Materials (Storage) Area** - an area or room used to store radioactive materials.

◆ **Hot Spot** - a localized source of radiation that is five times greater than the general background and is at least 100 millirem per hour.

◆ **Low Dose Area** - an area with a lower dose rate that workers can utilize to keep their dose ALARA.

◆ **Hot Particle Area** - an area that contains discrete radioactive particles that can give a large localized dose in a short period of time.

◆ **Radiography in Progress** – an area where radiography is occurring and access of personnel is controlled.

Refer to the ROG Specific Study Guide(s) for additional information
State the potential consequences of violating, moving, or altering a radiological posting

The moving or violating of a radiological posting could result in a radiological hazard, increased dose to personnel, or regulatory noncompliance. Personnel access to the RPA may be suspended until the situation is investigated.

If you are working in an area that is roped off, and the rope may need to be moved or adjusted, contact RP/Rad Con. The RP/Rad Con Department can evaluate the best way to serve your needs and still maintain regulatory compliance.

Climbing over fences, barriers, and gates is not permitted.

**Reaching over rad rope is strictly prohibited
unless specifically authorized by RP.**

K. RADIOLOGICAL ALARMS

Identify the radiological alarms used in the plant and state the proper response to a given radiological alarm

The following are typical radiological alarms that are used in the plant:

- ◆ Continuous Air Monitor (CAM)
 - ◇ Samples the air.
 - ◇ If an abnormal amount of airborne radiation is detected, the unit will alarm.
 - ◇ If alarming, leave the area immediately and report the situation to the RP/Rad Con Department.
- ◆ Area Radiation Monitor (ARM)
 - ◇ Detects radiation.
 - ◇ If radiation in an area is above the normal levels, the ARM will alarm (alarms in the immediate area or the Control Room or RP/Rad Con office).
 - ◇ If alarming, leave the area immediately and report the situation to the RP/Rad Con Department and Control Room.

Refer to the ROG Specific Study Guide(s) for additional information on Radiological Alarms

State the potential consequences of ignoring a radiological alarm

Improper response or ignoring a radiological alarm can increase your radiation dose and consequently, health risk.

Anyone who purposely ignores a radiological alarm will have their unescorted access to the RPA suspended until which time a full investigation may be completed.

L. RADIOACTIVE WASTE

Define "radioactive waste"

- ◆ Radioactive waste is defined as any radioactive or contaminated material for which disposal is required
- ◆ Some other terms used to identify radioactive waste are:
 - ◇ Radwaste
 - ◇ DAW, meaning dry active waste
 - ◇ LSA, meaning low specific activity
- ◆ Examples of radioactive waste are:
 - ◇ Used Protective Clothing that is no longer serviceable
 - ◇ Used tape, gloves, and plastic bags from a contaminated area
 - ◇ Contaminated packing material brought into the RPA or RCA



Contrast the disposal costs of radioactive waste vs. non-radioactive waste

- ◆ All waste generated at a nuclear power plant must be classified as either clean or contaminated trash prior to disposal.
- ◆ The fee for disposing each type of trash varies dramatically since contaminated trash is only accepted at a few special burial facilities throughout the country.
- ◆ Any material taken inside the RPA is potentially contaminated waste. Even if it is not contaminated, there is an additional cost associated with sorting, surveying and segregating the waste.

State methods for reducing radioactive waste generation

- ◆ **Recycle.** Use items such as cloth bags, protective clothing, and tool bags whenever possible. Use velcro bands instead of tape.
- ◆ **Prevent waste generation by minimizing usage.** Bring only those items and quantities into the RPA that you really need. Do not bring in excess packing material or boxes.
- ◆ **Plan ahead.** Use good judgment and common sense when planning the job. Return tools and glass to a survey point to be deconned and reused or disposed of properly.
- ◆ **Minimize the spread of contamination.** Report spills or leaks to Radiation Protection so that they may be cleaned up promptly.
- ◆ **Minimize the use of hazardous chemicals.**
- ◆ **Segregate waste.**

Refer to the ROG Specific Study Guide(s) for additional information

Explain the importance of segregating radioactive waste from non-contaminated waste and hazardous waste and segregating wet vs. dry contaminated material

- ◆ Segregate waste
 - ◇ Once radioactive waste is generated, it is important to keep it separate from clean non-radioactive materials or trash.
- ◆ If potentially clean and contaminated trash are mixed together, there may be cross-contamination which will result in one of the following:
 - ◇ Increase in time, manpower, and cost to survey and separate radioactive vs. non-radioactive waste.
 - ◇ Increase in total amount of radwaste generated.
- ◆ Radwaste should also be segregated from other hazardous materials in use, e.g. chemicals. If chemicals are placed in the same trash as radwaste this may result in the generation of “mixed waste.” Disposal of a mixed waste is very difficult and extremely expensive.
- ◆
- ◆ Wet and dry contaminated waste should be segregated. If not,
 - ◇ More waste processing may be required.
 - ◇ The container may also leak or corrode and cause a radioactive spill.
 - ◇ The waste would have to be separated and dried prior to disposal since most disposal sites refuse to accept mixed dry and wet waste.

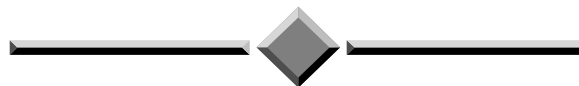
Refer to the ROG Specific Study Guide(s) for additional information

M. RIGHTS AND RESPONSIBILITIES

State the rights and responsibilities of the worker with regard to radiation protection (RP).

- ◆ Adhere to instructions provided by RP/RadCon personnel (including stop work orders), written policies and procedures, radiation work permits, and posted warnings, signs, and labels.
- ◆ Maintain awareness of your current accumulated dose for the job, day, and for the year.
- ◆ Keep your accumulated dose within federal limits and obtaining all required approvals prior to exceeding site administrative exposure control levels.
- ◆ Maintain your accumulated dose ALARA.
- ◆ Inform RP personnel and supervision when abnormal radiological conditions and/or violations of radiological requirements are encountered.
- ◆ The right to report NRC rule violations and safety concerns directly to the NRC. However, the NRC encourages workers to raise concerns with site supervision.
- ◆ Request and review your radiation dose records. In addition, you may request a written report of your exposure history upon completion of employment at the site.

Refer to the ROG Specific Study Guide(s) for additional information



GLOSSARY

ALARA - It is the policy of Exelon to maintain occupational dose equivalent to the individual and the sum of dose equivalents received by all workers As Low As Reasonably Achievable.

ALPHA PARTICLE - A charged particle emitted from atomic nucleus, with mass and charge equal to those of helium nucleus: two protons and two neutrons.

ATOM - The smallest particle of an element that can exist alone or in combination. It consists of a nucleus and a less dense outer area consisting of electrons in motion.

BETA PARTICLE - Charged particle emitted from the nucleus of an atom, with mass and charge equal to those of an electron.

BOILING WATER REACTOR - (BWR) - A nuclear power reactor in which steam is generated within the core and passed through a series of separators and dryers to the turbine generator.

CEDE - The overall dose equivalent received by the whole body based on internal exposures to the organs or tissues.

CHAIN REACTION - A reaction that stimulates its own repetition. In fission chain reactions, a fissionable nucleus absorbs a neutron and fissions, releasing additional neutrons. These in turn are absorbed by other fissionable nuclei releasing still more neutrons. A fission chain reaction is self-sustaining when the number of neutrons produced is greater than the number of neutrons lost by absorption or by escape from the system.

CONTAMINATION - Uncontained radioactive material where it does not belong.

COUNTS PER MINUTE (CPM) - Number of emitted particles counted per minute by a detector.

CURIE (Ci) - Unit of activity = 3.7×10^{10} nuclear transformations per second (dps). Common factors are:

millicurie - One thousandth of a curie (mCi)

microcurie - One millionth of a curie (μ Ci)

nanocurie - One billionth of a curie (nCi)

picocurie - One millionth of a microcurie (pCi)

DDE - The dose received by the whole body from external exposure.

DECAY, RADIOACTIVE - Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles, photons, or both.

DOSE - A general term denoting the quantity of radiation energy absorbed; for radiation protection purposes, must be qualified. If unqualified, this term refers to the absorbed dose.

DOSE EQUIVALENT - The product of the absorbed dose in tissue and a quality factor. Units of rem or millirem.

ELECTRON - A negatively charged particle that forms part of the atom outside of the nucleus. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

EXPOSURE - A measure of the ionization produced in air by X or gamma radiation. A unit of exposure in air is the roentgen (R).

FISSION - The splitting of a heavy nucleus into approximately two equal parts (which are nuclei of lighter elements). Accompanied by the release of a relatively large amount of energy. Fission can occur spontaneously but usually is caused by nuclear absorption of gamma rays, neutrons, or other particles.

FISSION PRODUCTS - Element or compounds resulting from fission.

GAMMA RAY - Short wavelength electromagnetic radiation of nuclear origin (range of energy, 10 keV to 9 MeV)

HALF-LIFE, RADIOACTIVE - Time required for a radioactive substance to lose fifty percent of its activity by decay.

HIGH RADIATION AREA - An area with dose rates greater than 100 mrem DDE/hr at 30 cm from the source.

ION - Atomic particle, atom, or chemical radical bearing an electric charge, either positive or negative.

IONIZATION - The process by which a neutral atom or molecule acquires a positive or negative charge.

LDE - Dose to the lens of the eye resulting from external exposure.

NEUTRON - An electrically neutral particle whose mass is approximately equal to that of a proton and is present in all atomic nuclei except ordinary hydrogen.

NUCLEAR POWER REACTOR - A device in which a fission chain reaction can be initiated, maintained and controlled. Its' essential component is the reactor core, which contains fissionable fuel. In addition to the core, it usually has a moderator, a reflector, shielding, coolant, and control mechanisms. Energy produced by a nuclear power reactor is generally used to make steam to drive a turbine that in turn drives an electric generator.

NUCLEUS, NUCLEI - The small positively charged core of an atom. It is only about 1/10,000 the diameter of the atom (determined by the position of the electrons), but contains nearly all of the atom's mass. All nuclei contain both protons and neutrons, except the nucleus of ordinary hydrogen which consists of a single proton.

OCCUPATIONAL DOSE - Dose received while working at a nuclear power plant.

PERSON-REM - Unit of collective exposure obtained by summing individual dose-equivalent values for all people in the population. Thus, the number of person-rem's contributed by 1 person exposed to 100,000 mrem is equal to that contributed by 100,000 people each exposed to 1 mrem.

PRESSURIZED WATER REACTOR - (PWR) - A nuclear power reactor in which heat is transferred from the core to the coolant by water kept under high pressure in order to achieve a high temperature without boiling in the primary system. Steam is generated in the heat exchanger of the secondary system for use in the turbine/generator.

PROTECTED AREA - Security area inside the double fence.

PROTON - A particle with a single positive charge and a mass approximately 1,837 times that of the electron. Protons are found in all nuclei.

QUALITY FACTOR (S) - A number which associates the source of radiation to the damage that the radiation will produce in tissue. Example: the quality factor for neutron dose is higher than the quality factor for beta dose because neutron dose is more penetrating and therefore more damaging to tissue.

RAD - (Radiation Absorbed Dose) The unit of energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest.

RADIATION - The emission and propagation of energy through space or through matter in the form of waves, such as electromagnetic waves or sound waves, or particles.

- **BACKGROUND RADIATION** - The radiation in man's natural environment, including cosmic rays and radiation from naturally radioactive elements, both outside and inside the bodies of humans and animals. It is also called natural radiation.
- **EXTERNAL RADIATION** - Radiation from a source outside the body.
- **INTERNAL RADIATION** - Radiation from a source within the body as a result of the deposition of radionuclides in tissue.
- **IONIZING RADIATION** - Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

RADIATION AREA - An area with dose rates greater than 5 mrem DDE/hr at 30 cm from the radiation source.

RADIOACTIVITY - The property of some nuclides of spontaneously emitting particles or gamma radiation or of emitting X radiation after orbital electron capture or of undergoing spontaneous fission.

RADIOLOGICALLY POSTED AREA - Any area, within the restricted area, where radioactive materials exists such that controlling entry to and exit from the area via RWP is required.

RADIOSENSITIVITY - Relative susceptibility of cells, tissues, organs, and organisms to the injurious action of radiation.

REM - Unit of dose equivalent. The product of absorbed dose and a quality factor. 1 rem = 1,000 mrem

RESTRICTED AREA - An area, access to which is limited by the licensee for the purpose of protecting people against undue risks from radiation.

ROENTGEN (R) - Measurement of ionization in air from X-Ray or gamma radiation. 1 R = 1,000 mR.

SDE - The dose received by the skin of the whole body or by the extremities from external exposure.

"TAILGATING" - Occurs when two or more persons enter into a protected or vital area through a door on only one authorized entry control card.

TEDE - The total dose to an individual resulting from internal and external exposures (DDE + CEDE).

VERY HIGH RADIATION AREA - An area in which radiation levels are in excess of 500 rad/hr at 1 meter from the source.

X-RAY - Penetrating electromagnetic radiation whose wavelength is shorter than that of visible light; usually produced by bombarding a metallic target with fast electrons in a high vacuum; in nuclear reactions, it is customary to refer to photons originating in the extra-nuclear part of the atom as X-rays.

