General Employee Radiological Training (GERT) Study Guide

The following comprise a short version of the GERT study guide. Understanding these Learning Objectives will greatly assist you in passing the GERT Challenge Exam.

The NSLS is classified as a low hazard facility with respect to radiation and most NSLS staff and users receive no recordable dose. Nevertheless, as required by Department of Energy regulations, all unescorted staff and users are required to complete radiological training for facility access. This training is specifically intended for workers who may routinely enter Radiologically Controlled Areas and encounter radiological postings. Successfully completing this portion of the NSLS Orientation will:

- qualify you for unescorted access to Controlled Areas at BNL, including the NSLS Experimental Floor and SDL (Source Development Laboratory)
- allow you to handle low level, sealed radioactive sources (small sources used for instrument response checks).
- authorize you to escort untrained personnel onto the Experimental Floor for a maximum of 8 hours, as long as these personnel are not participating in an experiment (observing only).

Learning Objective: Differentiate between ionizing and non-ionizing radiation and list some sources.

Radiation is energy in the form of sub-atomic particles or electromagnetic waves.

Radiation that has insufficient energy to remove electrons from atoms within material is classified as non-ionizing radiation.

- Examples include most visible light, infrared light, microwaves, and radio waves.
- Some common sources of non-ionizing radiation include microwave ovens, cellular telephones, and commercial radio transmitters.

When radiation has sufficient energy to remove electrons from atoms, a process known as ionization, the radiation is classified as ionizing radiation.

- For the purposes of this training course, examples of ionizing radiation include alpha, beta, gamma or x-rays, and neutrons.
- Sources of ionizing radiation include radioactive materials (e.g. uranium, thallium, Am-241) as well as radiation generating devices such as the NSLS X-Ray Ring and VUV Ring, and medical/dental x-ray machines.

Learning Objective: Differentiate between non-occupational and occupational dose.

Exposure to radiation is generally discussed in two broad categories:

- **Radiation doses to the general public (non-occupational)**.
  Examples of non-occupational radiation:
  - Natural sources - radon gas; cosmic radiation from outer space and our own sun; terrestrial sources such as naturally occurring radium, uranium, and thorium; internal sources within our own bodies.

  - Man-made sources - medical/dental source (diagnostic or therapeutic uses of radiation); consumer products; fallout from bomb testing or accidents such as Chernobyl.

- **Radiation dose received while performing work for your employer (occupational)**.
  This includes any dose from previous employers, as well as dose received during military or business-related travel.

Learning Objective: Identify the primary risk associated with exposure to chronic radiation doses.

"Chronic" radiation doses occur in low levels, for an extended period of time. Most occupational radiation exposure falls into this category.

Biological effects from such doses may occur in the exposed individual or in the future children of the exposed individual. There is a slight risk that cancer may be caused by chronic radiation doses. The risk is small, however, compared to the natural occurrence of cancer. Based primarily on human studies, the National Academy of Sciences, National Council on Radiation Protection and Measurement, and the International Commission on Radiation Protection have estimated the average risk to an adult of fatal cancer from radiation: A member of the general population of the United States has a roughly 20% chance of dying from cancer - the national cancer mortality rate. If this person were to receive an occupational dose of 1000 mrem over the course of their lifetime, their risk of developing fatal cancer would increase from 20% to 20.04%.

Learning Objective: Identify the annual radiation dose that a GERT qualified worker is expected not to exceed.

To minimize the potential risk of biological effects associated with radiation exposure, dose limits and administrative control levels (ACLs) have been established. The whole body dose limit for any radiological worker (including GERT-trained personnel) is 5000 mrem in a year. The DOE annual ACL is 2000 mrem, and the BNL annual ACL is 1250 mrem. In addition, each BNL Department has its own level below the BNL ACL.

You, as a GERT-trained worker, may access only areas posted as Radiologically Controlled Areas or Radioactive Material Areas within Controlled Areas, and are allowed to handle only limited quantities of radioactive materials. If a GERT-trained person does not enter any areas requiring personal dosimetery, that individual will likely spend the entire year in areas where the annual dose will be less than 100 mrem.

Learning Objective: Compare the occupational risks from radiation to health risks in industry and daily life.

The following tables may be used to gain perspective of the risk associated with exposure to radiation:

Cause of Death	Deaths per million people
Cardiovascular disease	4780 per year
Cancer	1700 per year
Motor vehicle accidents (car, truck, etc.)	220 per year
Radiation effects (per rem)	9 per year

Industry	Number of days lost annually
Mining and quarrying	328
Construction	302
Agriculture	277
Radiation accidents (deaths from exposure)	less than 1

Learning Objective: State the potential effects associated with prenatal radiation dose.

As with many other physical factors that are known to have an adverse effect on a developing embryo or fetus, such as smoking or consuming alcohol, radiation exposure may pose harmful effects to an unborn child. Studies have linked excessive radiation exposure to low birth weight, retarded growth, and a potential increased risk of developing childhood cancer.

Learning Objective: State the BNL policy concerning a declared pregnant worker.

Any woman working in radiological areas, who becomes pregnant, has the option of voluntarily notifying her supervisor in writing that she is pregnant. Upon receipt of this written notification she is classified a "declared pregnant worker". The policy of BNL is to offer the declared pregnant worker two work options:

- **"zero dose" option:** Identify a mutually agreeable assignment without loss of pay or promotional opportunity, such that further occupational exposure is unlikely.
- **"low dose" option:** Allows the declared pregnant worker to continue working in radiological areas with the DOE dose limit of 500 mrem throughout the gestation period applied. Also, the BNL administrative control level of 40 mrem per month is applied.

Learning Objective: Apply the concepts of using time, distance, and shielding to reduce radiation exposure. (Concept of "ALARA" - As Low As Reasonably Achievable)

- Pre-plan your work in radiation areas by using models to prove equipment or procedures.

- Take the best route to the job site - not necessarily the shortest, but the one which goes through the lowest radiation areas.
- Prepare tools and equipment and parts assembly before entering the area.
- Work efficiently and quickly.
- Eliminate rework by doing the job right the first time.
- Use long-handled tools, mechanical arms, and robotics to increase your distance from the source.
- Take advantage of permanent shielding, and position yourself so that it is between you and the source.

Learning Objective: State the purpose of and identify the proper use of personal dosimetry.

In 1996, BNL replaced the film badge with the thermoluminescent dosimeter (TLD). As with the old style film badge, the TLD offers not protection from radiation but monitors your exposure to beta, gamma, and neutron radiation. The TLD is the basis for the legal record of your dose, so there are many rules and requirements regarding the use of the TLD.

- TLDs must be worn on the front of the body between the neck and waist, with the colored label facing outward. The best location is the center of the chest.
- Place your TLD on the badge board when you leave the building. If you take it home by mistake, return it the next day.
- A TLD issued at BNL should not be worn at another Laboratory or organization and dosimetry issued from another Laboratory or organization should not be worn at BNL.
- Never wear another worker's TLD, and never allow others to wear yours.
- Report a lost or damaged TLD immediately to your Facility Support Representative (see NSLS Radiological Control Division Staff). TLDs can be damaged by being washed with your clothes, being left in the sun, accidentally popping open (as when dropped).
- Medical procedures using radiation: Notify the Facility Support Representative (see NSLS Radiological Control Division Staff) if you accidentally wore your TLD during a medical x-ray or if you have undergone a thallium stress test or any other procedure which requires injecting radioactive materials into your body.

Learning Objective: State the processing and record-keeping schedules for personal dosimetry.

TLDs are collected and processed monthly, usually the first weekend of the month. If you have a "permanent" TLD, your old one will be automatically replaced as long as your radiological training is up to date. If you have a temporary TLD (month-to-month, as needed) then you will need to obtain a new one from the User Administration Office.

Although the information from your personal dosimetry is processed monthly, you will receive a written summary of your annual cumulative dose each year. You may request additional reports of your dosage at any time by contacting the BNL Personnel Monitoring Group.

Learning Objective: Identify the purpose and scope of the BNL policy regarding your responsibility and authority for stopping non-compliant radiological work.

The Laboratory Director has empowered each and every individual who has received radiological safety training, including GERT, with the authority and responsibility to immediately stop non-compliant or unsafe radiological work (Radiological Stop Work Policy). Such work may include:

- Willfully bypassing a radiological safety interlock.
- Realizing that a Work Control document involves unforeseen radiological exposures.

If you are issued a Radiological Stop Work Order, you must:

- Stop working on the affected activity as soon as safely possible.
- Place the workplace in a safe condition.
- Report to your supervisor and explain why the Order was issued. (Users should report to their supervisor, if present at BNL, and also an Operations Coordinator.)
- DO NOT resume work until safety reviews are performed and your Department Chair (with concurrence from the Radiological Control Division) authorizes you to restart work.

Learning Objective: State the purpose of the BNL Radiological Awareness Report (RAR) program.

The Radiological Awareness Report (RAR) program is your avenue of communication between daily work activities and management concerning deficiencies in the administration of our Radiological Controls program. If you have a concern you would like to communicate to the Radiological Control Division, you should complete a Radiological Awareness Report. With information from you, management will be able to identify program weaknesses and shortcomings, specify corrective actions, and develop action plans for improvement. If you have any questions regarding the RAR program you may contact Andrew Levine at x 4408.

Learning Objective: Identify the purpose and scope of the Price Anderson Amendments Act (PAAA) relating to the potential impact of non-compliant radiological work.

The Price Anderson Amendment Act is a Congressional act designed to protect the health and the safety of workers and the general public. The Act specifies that the DOE will insure its primary contractors (BSA) against liability arising from nuclear or radiological activities performed within the scope of the BSA Contact.

To reduce the risk of events that may require indemnification, the Act authorized civil and criminal penalties for violation of DOE regulations such as Occupational Radiation Safety and Quality Assurance.

Personnel demonstrating willful non-compliance may receive disciplinary action, which can range anywhere from suspension up to and including dismissal.

All employees, guests, contractors, and outside suppliers are responsible to adhere to these regulations. It is each person's responsibility to identify, report, and correct any known non-compliance issue.