Changes to NRRPT® Examination Objectives
Effective June 1, 2020

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The **NRRPT®** Board of Directors has approved changes to the learning objectives that will be evaluated by the **NRRPT®** Examination. These objectives will replace the existing **NRRPT®** role delineation rubric currently posted on the **NRRPT®** web site (NRRPT.org).

Background –

The original **NRRPT®** Board of Directors and Panel of Examiners assembled a list of tasks performed by Radiation Protection Technologists (RPTs) known as the **NRRPT®** "Content Specification." The list was as complete as it could be for the time; the Board and Panel determined what knowledge was necessary to perform the tasks. These knowledge factors were organized into major categories, which then became the Role Delineation and basis for testing a candidate's knowledge level.

The Role Delineation was reviewed by the Board and Panel from 1985 to 1987 and condensed from its five major categories to the current three categories. The numerous sub-categories were also condensed into the current 18 subcategories and grouped under the three major categories of "Applied Radiation Protection," "Detection and Measurements," and "Fundamentals." The end product was the **NRRPT®**'s Role Delineation.

In 1987 the Board and Panel members decided what percent of the examination should be devoted to each of the three major categories and their respective sub-categories. The percentages were then averaged for each of the major and sub-categories. The resultant averages determined the current exam blueprint. The categories were all assigned a numerical sequence known as a "Rubric" to individually identify it.

New Task Evaluation Process –

Starting in 2016, the **NRRPT®** commenced an updated task evaluation process with the goals of both updating RPT tasks and more clearly communicating to prospective registrants the depth and breadth of knowledge necessary for successfully passing the **NRRPT®** examination.

This process reviewed expected radiation protection knowledge objectives from INPO and DOE as well as representative information from the medical and military fields. These objectives were then combined into new common categories and a new exam blueprint was developed. After significant

discussion and review by the **NRRPT®** Board of Directors and Panel of Examiners the new process was approved.

End Result –

The following list of Categories and respective Objectives are now being used for examination development starting with the August 2020 **NRRPT®** examination. As before, there will be a single passing point determined by the **NRRPT®** for each individual examination. Additionally, the process used to develop, grade and score the examination has not changed.

Listing of Knowledge Objectives –

A Mathematics
- 1 Perform basic arithmetic functions including: addition, subtraction, multiplication, division, fractions and decimals, percentage, square roots and ratios
- 2 Perform calculations that involve logarithms/exponential functions including: graphing, solving for the exponent, solving for any variable, base e, base 10
- 3 Apply scientific and engineering notation in calculations including conversion of numbers
- 4 Perform algebraic operations to solve health physics situations
- 5 Understand the basic principles of geometry and trigonometry and utilize these principles to solve basic mathematical problems

B Unit Analysis and Conversion
- 1 Apply the basic units of measure encountered by radiation technicians including relationships between each system
- 2 Demonstrate the ability to apply the concept of dimensional analysis and to perform: unit conversions, unit modifiers, metric measurements such as conversion between metric and the U.S. customary system

C Physics
- 1 Apply the basic classical physics relationships of motion, force, work, power and energy to solve situations common to health physics
- 2 Define the term acceleration and either calculate acceleration or use acceleration to calculate distance and/or velocity.
- 3 Define energy, both kinetic and potential, and calculate the energy that an object possesses

D Basic Atomic and Nuclear Physics

1 Identify the basic structure of the atom, including the characteristics of subatomic particles
2 Define the following terms: Atomic number, Mass number, Atomic mass, Atomic weight, atomic mass unit, element, molecule, compound
3 Identify what each symbol represents in the $^{A}_{Z}X$ notation
4 Define the following terms: Nucleon, nuclide, isotope, isotone, isobar, isomer
5 Identify the basic principles of the mass-energy equivalence concept
6 Define mass defect, binding energy, binding energy per nucleon
7 Utilize the concepts of mass defect and binding energy to perform binding energy calculations
8 Explain the basic fission process including: theory of fission process (delayed and prompt neutrons, thermal and fast neutrons), control of fission process, neutron flux effects on reactor power, neutron leakage, fission products, neutron sources, radiation from fission and from fission products
9 Define fusion
10 Explain residual heat/decay heat including sources of decay heat (describe sources of decay and residual heat and its significance)

E <u>Sources of Radiation</u>

1 Identify the following sources of natural background radiation including the origin, radionuclides, variables, and contribution to exposure: Terrestrial, Cosmic, Internal Emitters, Radon gas (including daughter products)
2 Identify the following sources of man-made background radiation including the origin, radionuclides, variables, and contribution to exposure: Nuclear Fallout, Medical Exposures, Consumer Products, Nuclear Facilities
3 Identify and quantify potential sources of exposure to the public from: plant liquid and gaseous effluent releases, transportation of radioactive materials, major accident
4 Identify and quantify potential sources of exposure to nuclear power plant workers from: primary system piping and components, inside containment during power operation, primary system filters and demineralizers, radwaste process systems

F <u>Radioactivity and Radioactive Decay</u>

1 Identify how the neutron to proton ratio is related to nuclear stability
2 Define radioactivity, radioactive decay, specific activity and radioactive half-life
3 Identify the characteristics of alpha, beta, and gamma radiations
4 Identify the following radioactive decay modes: alpha decay, beta decay, positron decay, electron capture
5 Use basic equations to describe each type of decay

6 Identify the three naturally-occurring radioactive series, the element each series ends with, and given a radioactive isotope in ${}^{A}_{Z}X$ notation with the method of decay identify the correct progeny from a given list

7 "Explain key radiological characteristics of the following important radionuclides encountered in radiation safety in nuclear power generation, research, industrial applications and radiography and in diagnostic and therapeutic nuclear medicine

Radionuclides:

H-3, C-14, N-16, P-32, Co-60, Sr/Y-90, Tc-99m, I-125, I-131, Cs-137, Ir-192, Ra-226, U-235, U-238, Pu-239 and Am-241

Key radiological characteristics:

- Typical significance in health physics and routes of exposure
- Mode of decay and main radiation emissions
- Typical significance in occupational exposure as an external hazard
- Typical significance in occupational exposure as an internal hazard
- Methods for detection
- General methods for internal dosimetry
- General methods for external dosimetry"

8 Identify and use radiological quantities and their units including: activity (curies and becquerels, disintegrations per second, disintegrations per minute), exposure (roentgens), dose (rads and grays), dose equivalent (equivalent dose) (rems and sieverts)

9 List the types of radiation and their associated quality factors/radiation weighting factors

10 Given an absorbed dose and type of radiation, calculate the dose equivalent (equivalent dose) in conventional and System International (SI)

11 Describe the three types of special case series decay situations (secular, transient and no equilibrium)

12 Calculate activity, time of decay, and radiological half-life using the formula for radioactive decay

13 Describe how kVp, mA relate to x-rays

14 Describe how x-rays are produced within an x-ray tube

15 Identify the types and uses for accelerators.

16 State the type(s) of particles accelerated in a given type of accelerator

17 Define prompt radiation from an accelerator

18 Define radioactivation from an accelerator

19 Identify activation and ancillary sources at an accelerator

20 Identify activation products from an accelerator

G Interaction of Radiation with Matter

1 Define: excitation, ionization, secondary ionization, specific ionization, bremsstrahlung
2 Define: linear energy transfer, stopping power, range, W-value
3 Describe alpha particle emission; discuss its specific ionization and range; and state the implications of this as it applies to radiation protection
4 Describe beta particle emission; discuss its specific ionization and range; and state the implications of this as it applies to radiation protection
5 Describe the process of electron capture and subsequent characteristic x-ray emission
6 Describe the properties of photons and how they interact with matter
7 Describe why there is a requirement for a certain minimum photon energy for pair production to occur.
8 Describe the dependence of photoelectric effect, Compton scattering, and pair production, upon the atomic number of the absorber and energy of the incident photon
9 Define fast neutron, thermal neutron, cross-section, and barn
10 Describe the processes and characteristics of neutron interaction with matter including: elastic scattering, inelastic scattering, absorption, neutron activation, fission, charged particle emission
11 Identify the basis for differentiation of neutron radiation energies when determining potential biological dose
12 Given a description of a neutron radiation field, identify the principle biological hazard it represents and compare it to the hazard created by other types of radiation
13 Define linear absorption coefficient and mass absorption coefficient, linear attenuation coefficient and mass attenuation coefficient for gamma interactions.
14 Based on knowledge of interaction mechanics, select preferred materials for shielding each type of radiation
15 Define buildup factor
16 Identify common shielding practices for beta particles (low Z number materials), neutrons (hydrogenous material) and gammas (high density, high Z number materials)
17 Describe the phenomenon of "sky shine" and the means by which it can be minimized
18 Perform shielding calculations
19 Describe and define Half Value Layer and Tenth Value Layer

H Biological Effects of Radiation

1 Identify the function of the following cell structures: cell membrane, cytoplasm, mitochondria, lysosome, nucleus, DNA, chromosomes
2 Describe the mechanisms of radiation interactions with cells (primary, secondary/free radicals)
3 Define the law of Bergonie and Tribondeau
4 Identify factors which affect the radiosensitivity of cells

5 Given a list of types of cells, identify which are most or least radiosensitive
6 Identify primary and secondary reactions on cells produced by ionizing radiation
7 Define stochastic and non-stochastic (deterministic) effects
8 Identify the LD 50/30 value for humans
9 Explain the difference between acute and chronic radiation exposure
10 Identify the possible somatic effects of chronic exposure to radiation
11 Identify the possible hereditary effects of chronic exposure to radiation
12 Identify the possible teratogenic effects of chronic exposure to radiation
13 For acute exposures, describe the dose response relationship
14 For acute exposures, describe acute radiation syndrome
15 Distinguish between the three phases of the acute radiation syndrome, and identify the exposure levels and the symptoms associated with each
16 For chronic exposures, describe the long-term health effects
17 For chronic exposures, describe the quantitative risk assessment
18 For chronic exposures, compare radiation exposure risks to other health risks
19 Describe the potential health effects and risks due to exposure to internally deposited radioactivity
20 Discuss the basis for and implications of the linear no-threshold (LNT) dose-response curve
21 Identify risks of radiation exposure to the developing embryo and fetus
22 Given a description of prenatal irradiation effects, select the effect to the developmental stage in which the radiation exposure is likely to cause the effect
23 Define radiopharmaceutical
24 Define hormesis theory

I <u>Radiological Protection Standards</u>

1 Discuss the historical development of radiological protection standards
2 Explain the purpose of radiological protection standards and guidelines
3 Identify the role of advisory agencies in the development of recommendations for radiological control
4 Identify the role of regulatory agencies in the development of standards and regulations for radiological control
5 Identify the scope of 10 CFR 835--"Occupational Radiation Protection"
6 Define and discuss the interrelationship among the following: regulation, regulatory guide, NUREG, recommendation (health physics position papers), license condition, technical specification
7 Discuss the philosophy of radiation protection limits, including the prevention of non-stochastic (deterministic) effects, minimization of stochastic effects, concept of "acceptable risk" or "comparable risk", concepts of "cost versus benefit" and ALARA

8 Explain the principles and use of 10 CFR 19--"Notices, Instructions, and Reports to Workers"
9 Explain the principles and use of 10CFR 20--"Standards for Protection Against Radiation"
10 Define the FDA standard as defined in 21 CFR 1020.40 for cabinet x-ray leakage
11 Explain the principles and use of 10CFR 34--"Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations"
12 Define the patient release criteria from 10 CFR 35.75

J ALARA

1 Describe the assumptions on which the current ALARA philosophy is based
2 Discuss the concept of effective dose equivalent (effective dose) and how it applies to planning work in contaminated areas and radiation fields
3 Identify the ALARA philosophy for collective personnel exposure and individual exposure
4 Identify the scope of an effective radiological ALARA program
5 Identify the purposes for conducting pre-job and/or post-job ALARA reviews
6 Identify RCT responsibilities for ALARA implementation
7 Describe situations where the risk due to exposure to internally deposited radioactivity would be lower than the increased risks that would result from the use of respiratory protective equipment

K External Exposure Control

1 Apply the principles of the four basic methods for minimizing personnel external exposure (time, distance, shielding, source reduction)
2 Using the Exposure Rate = 6CEN equation, calculate the gamma exposure rate for specific radionuclides
3 Using the stay time equation, calculate an individual's remaining allowable equivalent dose (dose equivalent) or stay time
4 Using the point source equation (inverse square law), calculate the exposure rate or distance for a point source of radiation
5 Using the line source equation, calculate the exposure rate or distance for a line source of radiation
6 Identify how exposure rate varies depending on the distance from a surface (plane) source of radiation, and identify examples of plane sources
7 Identify the definition and units of "mass attenuation coefficient" and "linear attenuation coefficient"
8 Identify the definition and units of "density thickness"
9 Identify the density thickness values, in mg/cm2, for the skin, the lens of the eye and the whole body
10 Calculate shielding thickness or exposure rates for gamma/x-ray radiation using the equations

11 Given various shielding materials, discuss the effectiveness of the shielding material on alpha, beta, and gamma radiations; contrast good and bad geometry effects; and discuss bremsstrahlung effect

L Internal Exposure Control

1 Identify four ways in which radioactive materials can enter the body and identify methods to prevent or minimize entry by those pathways
2 Identify the definition and distinguish between the terms "Annual Limit on Intake" (ALI) and "Derived Air Concentration" (DAC)
3 Identify the basis for determining Annual Limit on Intake (ALI)
4 Define "reference man"
5 Identify a method of using DACs to minimize internal exposure potential
6 Identify three factors that govern the behavior of radioactive materials in the body
7 Identify the two natural mechanisms which reduce the quantity of a radionuclide in the body
8 Identify the relationship between the physical, biological and effective half lives
9 Given the physical and biological half lives, calculate the effective half life
10 Given a method used by medical personnel to increase the elimination rate of radioactive materials from the body, identify how and why that method works
11 Define bioassay, intake, uptake, in-vitro measurement, and in-vivo
12 Estimate dose from swallowing or breathing radioactivity
13 Define critical organ
14 Describe the causes of uncertainties in internal dose assessment calculations

M Radiation Detector Theory

1 Identify the three fundamental laws associated with electrical charges
2 Explain the function of the detector and readout circuitry components in a radiation measurement system
3 Identify the parameters that affect the number of ion pairs collected in a gas filled detector
4 Explain gas-filled detector six region curve, including gas amplification
5 Identify the characteristics of a detector operated in each of the useful regions of the gas amplification curve
6 Define resolving time, dead time and recovery time
7 Identify the methods employed with gas-filled detectors to discriminate between various types of radiation and various radiation energies
8 Discuss the energy dependency of a GM counter
9 Discuss aspects and purposes of the filling and quenching gas
10 Identify how a scintillation detector and associated components operate to detect and measure radiation

11 Identify how neutron detectors detect neutrons and provide an electrical signal
12 Identify the principles of detection, advantages and disadvantages of a GeLi detector and an HPGe detector
13 Explain the Compton edge, Compton continuum, photopeak, backscatter peak, summation peak, annihilation and escape peak

N Counting Errors and Statistics

1 Identify the general types of errors that can occur when analyzing radioactive samples, and describe the effect of each source of error on sample measurements
2 Given a set of data, calculate the mode, median, mean, range, variance, and standard deviation
3 Define the terms precision and accuracy
4 State the purpose of a Chi-squared test
5 State the purpose of creating quality control (QC) charts
6 Read data from linear and logarithmic coordinate system graphs
7 State the purpose of calculating warning and control limits
8 State the purpose of determining efficiencies and correction factors
9 Given counting data and source assay information, calculate efficiencies and correction factors
10 Given counting results and appropriate formulas, report results to desired confidence level
11 Given a desired relative standard error and confidence level, calculate the number of counts required to achieve the given percent error and confidence level
12 State the purpose of determining background
13 Define "detection limit," and explain the purpose of using detection limits in the analysis of radioactive samples
14 Given the formula and necessary information, calculate detection limit values for counting systems
15 State the purpose and method of determining crosstalk
16 State the purpose of performing a voltage plateau
17 Given data, determine the final result and report the result with the appropriate number of significant digits

O Dosimetry

1 Identify the external exposure limits from 10 CFR 835 for general employees
2 Identify the external exposure limits for a member of the public
3 Identify the external exposure limits for the embryo/fetus of a declared pregnant worker
4 Identify the external exposure limits from 10 CFR 20 for occupationally exposed individuals

5 Identify the requirements for a female general employee who has notified her employer in writing that she is pregnant
6 Given a list of anatomical locations/organ systems and a list of exposure limits, match the exposure limits to the anatomical locations or organ systems
7 Discuss the theory of operation of a thermoluminescent dosimeter (TLD)
8 Discuss how a TLD reader measures the radiation dose from a TLD
9 Identify the advantages and disadvantages of a TLD
10 Identify the types of beta-gamma personnel dosimeters
11 Identify the types of neutron personnel dosimeters
12 Determine the principle of operation, and the types used, for the personnel neutron dosimeters
13 Determine the principle of operation of self-reading dosimetry (SRD)
14 Determine the principle of operation, and guidelines for use, for the alarming dosimeters
15 Discuss the theory of operation of an optically stimulated luminescent dosimeter (OSL)
16 Discuss effects of fading and drift for TLDs and OSLs
17 Identify the advantages and disadvantages of an OSL
18 Describe when dosimetry is required for entry into restricted areas, radiologically restricted area, posted radiation areas, posted high radiation areas, posted very high radiation areas
19 Describe dosimetry requirements for neutron exposure
20 Describe dosimetry requirements for areas with non-uniform radiation fields
21 Describe the method to determine gamma whole-body dose, gamma extremity dose, beta skin dose, neutron dose
22 Describe the proper method for wearing dosimetry
23 Explain the use of multiple dosimeters, including proper placement and method of determining whole body dose
24 Discuss extremity dosimetry including types, placement, and assignment of dose
25 Describe what actions are required when a radiation worker reports the loss or damage of their personnel dosimeter
26 Describe the circumstances under which an administrative dose could be assigned
27 List the types of bioassay monitoring methods
28 List the advantages and disadvantages of the urine monitoring method for bioassay
29 List when a bioassay is necessary
30 Given a situation, discuss the frequency of the bioassay for the given situation
31 Define tissue weighting factors
32 Define solubility class
33 Identify, calculate and use the following significant dose terms: deep, lens of the eye, committed, committed effective, total effective, total organ dose equivalent (equivalent dose)

P Contamination Control

1 Define the terms "removable and fixed surface contamination," state the difference between them and list common methods used to measure each
2 State the limits for radioactive contamination for release of materials, equipment, and areas for unrestricted use
3 Discuss the reason for having lower limits for alpha contamination
4 Identify potential sources of radioactive contamination, including work operations that can generate contamination
5 Describe techniques for controlling the spread of contamination to personnel and equipment
6 Describe requirements for monitoring personnel for radioactive contamination
7 Discuss the use, advantages, disadvantages, and relative sensitivity of the following contamination detection devices: bag counters, conveyor-type contamination monitors, portable friskers, portal monitor, tool monitor, whole-body contamination monitor
8 Describe processes for controlling hot particles
9 Describe types of protective clothing available, including conditions under which each is used, procedures for donning and removing protective clothing and inspections of clothing prior to use
10 Describe the items used for containment of contamination during radiological work, such as drapes, glove bags, tents, drain bottles, berms, absorbents to contain liquid and catch containments
11 Describe methods used to protect against facial contamination
12 Identify the conditions in which the use of each type of containment device is to be considered
13 Explain the inspections that are to be performed prior to the use of containment devices
14 Describe techniques to minimize the spread of contamination
15 Define cross-contamination and describe how it can result in the uncontrolled spread of contamination
16 Describe the purpose and use of a stepoff pad in controlling the spread of contamination

Q Airborne Radioactivity Control

1 State the primary objectives of an air monitoring program
2 Describe the three physical states of airborne radioactive contaminants
3 List and describe the primary considerations to ensure a representative air sample is obtained
4 Define the term "isokinetic sampling" as associated with airborne radioactivity sampling

5 State the purpose of the primary types of airborne radioactivity samplers/monitors (personal air samplers, high volume samplers, low volume samplers, portable continuous air monitors, installed continuous air monitoring systems)

6 Identify the general methods for obtaining samples or measurements of airborne radioactivity concentrations and describe the principle of operation for each method (filtration, volumetric, impaction, impingement, adsorption, condensation/dehumidification, in-line/flow-through detection)

7 Describe the general considerations for selection of an air monitoring method

8 List the factors that affect the accuracy of airborne radioactivity measurements and describe how these factors affect sample accuracy

9 Describe air monitoring program monitoring frequencies

10 Describe air monitoring program calculational methods using applicable derived air concentration limits, derived air concentration hours and annual limit on intake

11 Describe the methods for determining radon interference

12 Given appropriate data from an air sample measurement and necessary equations, calculate the net activity

13 Identify the isotopes of primary concern for airborne radioactivity at a nuclear power plant

14 Evaluate trends in airborne radioactivity based on sampling results

15 Identify work situations and work practices that could produce airborne radioactivity

16 Describe controls that can be used to reduce exposure to airborne radioactivity

17 Identify requirements that must be met before an individual is issued a respirator

18 Define protection factor

19 Identify the protection factors, advantages, and disadvantages of each type of respirator used in radiological applications (full-face negative pressure, full-face positive pressure, full-face air-line, air-line hood, self-contained breathing apparatus)

20 Describe the conditions under which each type of respiratory protection equipment must be used

21 Discuss the difference between paper filters and charcoal filters and when each is used

22 State the difference between a qualitative and quantitative fit test

23 State how the term protection factor (PF) is applied to the selection of respiratory protection equipment

R <u>Radioactive Source Control</u>

1 Identify the characteristics of radioactive sources

2 Identify the packaging, marking, and labeling requirements for radioactive sources

3 Describe the process and procedures for storage and accountability of radioactive sources

4 Describe the precautions associated with calibration procedures and calibration source handling

5 Describe the use of calibration source decay curves
6 Describe source leak testing for alpha, beta, gamma, and neutron sources
7 Describe disposal of sources, including licensed and nonlicensed
8 Discuss the use of sources for calibrating radiological instruments and equipment
9 Discuss the situations that lead to sealed source leakage
10 Discuss the general procedure for brachytherapy using sealed sources of radiation

S Environmental Monitoring

1 State the goals of an environmental monitoring program
2 State the exposure limits to the general public as they apply to environmental monitoring
3 Define the term "critical nuclide"
4 Define the term "critical pathway"
5 Describe the methods used to conduct environmental monitoring (off-site TLDs, air sampling, vegetation sampling, aquatic life sampling, water sampling, soil sampling, milk sampling)
6 Describe actions to be taken if unexpected radioactivity is detected in environmental samples
7 Identify the major pathways of concern in performing off-site dose calculations
8 Describe periodic reporting requirements for environmental monitoring data

T Work Control/Job Coverage

1 State the purpose of and information typically found on a radiological work permit
2 Describe the concept of "total risk" as applied to prescription of radiological work controls
3 State purpose of radiological postings, signs, labels, and barricades; and the RCTs responsibilities for them
4 Describe good practices, support equipment to use, and common discrepancies in setting up radiological areas
5 Describe good practices in setting up portable ventilation systems
6 State the purpose of having plant administrative limits for radiation exposure
7 Explain the differences between general area dose rate and contact dose rate and how each is used to control exposures
8 Define and state the posting requirements for the following (10CFR20): controlled area, radiation area, high radiation area, very high radiation area, airborne radioactivity area
9 Define and state the posting requirements for the following (10CFR835): controlled area, radiation area, high radiation area, very high radiation area, contamination area, high contamination area, airborne radioactivity area, radioactive material area
10 Describe techniques for controlling individual exposures during radiological work (alarming dosimeters, stay times, low dose waiting areas, locked barriers, key control)

11 Appropriate survey instrument to use for various routine survey requirements
12 Describe precautions and survey techniques for entering an area where radiation levels are unknown
13 Identify techniques for controlling workers' exposure to beta radiation, such as the wearing of protective clothing, face shields and glasses
14 Explain how exposure goals can be used to reduce individual and collective exposures
15 Describe work time reduction techniques that can be used to reduce worker's radiation exposure
16 Describe techniques by which increased distance can be used to reduce workers' radiation exposure
17 Describe the consequences of removing permanent or temporary shielding without proper review and authorization
18 Discuss factors that determine the ultimate effectiveness of installing temporary shielding
19 Describe source reduction techniques that can be used to reduce workers' radiation exposures
20 List the purposes of providing RPT job coverage
21 Explain the differences between continuous and intermittent job coverage
22 Describe the methods that can be used to invoke radiological protection requirements such as: written procedures, radiation work permit, verbal instructions from supervisor, verbal instructions from radiological protection personnel
23 Explain the responsibilities of the following personnel regarding specifying, complying with, monitoring and enforcing radiological protection and ALARA requirements: workers, worker's supervisor, RPT, RPT Supervisor, Line Management, Radiation Safety Officer, Radiological Protection Management
24 Identify the information to be included on radiation work permits
25 Discuss actions that should be taken if radiological conditions at the job site are significantly different from those shown on the RWP
26 Identify the pre-job radiological survey considerations given a work operation to be performed
27 Identify items that should be considered in planning job coverage
28 Explain how the type and location of whole-body dosimetry is determined for body position and dose rate gradient
29 Identify the criteria used to determine the need for multiple badging or for extremity monitoring
30 Identify measures to take when protective clothing is used in conditions that could result in heat stress
31 Identify and explain factors that determine the need for and type of protective clothing to be used during radiological work

32 Identify generic locations that should be included in process radiation surveys, such as: component being worked on, nearby piping and components, location where workers are positioned, path to and from work site, low dose areas, hot spots, potentially transient areas

33 Define "breathing zone"

34 Define "radiation survey" and "radiation monitoring"

35 Explain the role of engineered controls, administrative controls and PPE

36 Discuss special radiological surveys and techniques for an accelerator

37 Describe hazards involved in I-131 thyroid ablation therapy

38 Discuss controls associated with radiography operations

U Radioactive Material Control

1 List the applicable federal agencies which have regulations that govern the transport of radioactive material

2 Define terms used in DOT regulations: Type A, Type B, low specific activity, surface contaminated objects, radioactive white I, yellow II and yellow III, highway route controlled quantity, limited quantity, exempt quantity, special form, normal form, empty

3 Identify the packaging, marking, and labeling requirements for radioactive materials stored on site

4 Identify NRC-licensed radioactive materials that require special controls, and discuss the controls required

5 Describe the approval and posting requirements for radioactive material areas and radioactive material storage areas

6 Identify special precautions and restrictions for storing radioactive materials outdoors

7 Describe the necessary radiation and contamination surveys to be performed on packages and state the applicable limits

8 Describe the necessary radiation and contamination surveys to be performed on exclusive use vehicles and state the applicable limits.

9 Identify the proper placement of placards on a transport vehicle

10 Identify DOT requirements for a Class 7 shipment

11 Explain the radiological protection requirements associated with processing liquid wastes using techniques such as: operation of evaporators, solidification of evaporate bottoms, transfer of demineralizer resin to shipping casks, dewatering and solidification of resins

12 Identify and explain techniques for reducing the volume of radioactive solid waste generated, such as the following: minimizing the amount of material entering the radiologically restricted area, decontamination, segregating non-radioactive waste, reusing cloth rags, shoe covers, bags and protective clothing, wrapping clean

equipment, compaction, using a "hot tool room", removing packing materials outside the radiologically restricted area

13 Define radioactive waste

14 List the methods of radioactive waste disposal

15 Describe the various classifications (long or short half-life) of radioactive waste per 10 CFR 20 and state the disposal procedure for each classification

V Radiological Incidents and Emergencies

1 List the proper steps for the treatment of minor injuries occurring in various radiological areas

2 List the requirements for responding to major injuries or illnesses in radiological areas

3 State the RCT's responsibility at the scene of a major injury in a radiological area after medical personnel have arrived at the scene

4 List the requirements for treatment and transport of contaminated injured personnel

5 Describe the general response and responsibilities of an RCT during any incident

6 Describe the RCT response to a Continuous Air Monitor (CAM) alarm

7 Describe the RCT response to a personnel contamination monitor alarm

8 Describe the RCT response to off scale or lost dosimetry

9 Describe the RCT response to rapidly increasing, unanticipated radiation levels or an area radiation monitor alarm

10 Describe the RCT response to a dry or liquid radioactive material spill

11 Describe the RCT response to a fire in a radiological area or involving radioactive materials

12 Describe the response levels associated with radiological emergencies

13 Describe the RCT response to a loss of a high-activity radiation source

14 Describe the RCT response to a degraded core

15 Describe the RCT response to a uncontrolled or unsecured high radiation areas

16 Describe how to estimate beta and gamma dose rates from the following: contamination on the floor, airborne radioactivity (particulate, iodines, noble gases and tritium), pipes or tanks that contain radioactive liquids

17 Describe how to estimate skin dose resulting from skin contamination including hot particles

18 Describe how to estimate dose due to ingestion or inhalation of radioactive materials

19 Estimate activity released during an incident using the following: airborne activity levels in a plume, contamination levels and extent of area contaminated, gaseous/particulate specific activity and volume released, liquid specific activity and volume released, pre-release and post-release radiation surveys (for example, pipe, valves, tanks)

20 Identify work practices, instrument responses, or alarms that indicate the potential for a radiological incident

21 Discuss the plant emergency response plan (plant specific), including: responsibilities of various work groups, personnel accountability, emergency operations center organization, on-site and off-site radiological emergency response, protective action guidelines for the public

22 Discuss emergency dose limits for life-saving or control of plant safety

23 List the protective clothing and devices used to protect fire fighters and others responding to an accident involving radioactive material

W Decontamination

1 Describe the "total risk" concept as it applies to contamination control

2 Explain the differences between fixed and removable contamination and the resulting differences in techniques used for decontamination

3 Describe the procedure to be followed when an individual is contaminated

4 Identify when nasal smears and/or a whole-body count are required

5 Explain the rationale of tracking and trending personnel contaminations

6 Explain why hot water, cold water and abrasive cleaners are not recommended for personnel decontamination

7 Select the appropriate personnel decontamination techniques for various levels of contamination: removing particles with tape, scrubbing gently with soft brush, shaving contaminated hair, sweating and chemical decontamination, washing with lukewarm water and mild detergent

8 Identify conditions in which skin dose calculations should be performed as a result of skin contamination

9 Identify situations in which personnel decontamination is to be referred to other appropriate personnel: contaminated wounds, contaminated eyes, ears, nose, or throat, contamination that cannot be removed using approved techniques

10 Describe special procedures for radioiodine decontamination

11 Discuss additional actions or notifications required if an injured person is contaminated

12 List the steps for using decontamination reagents to decontaminate personnel

13 Identify techniques available for decontamination of tools and equipment, including advantages, disadvantages, and limitations of each: carbon dioxide pellet blasting, chemical decontamination, electropolishing, grit blasting, high pressure water blasting, ice pellet blasting, low pressure water blasting, mechanical removal (grinding, machining, filing), spray wash, steam cleaning, ultrasonic cleaning, use of strippable coatings, wiping with lint free cloth or oil-impregnated wipes, washing in non-ionic detergent

14 Explain why area decontamination should begin at areas of lowest contamination levels and progress toward areas of high levels

X Radiological Instrumentation and Sampling Equipment

1 List the factors which affect an RCT's selection of a portable radiation survey instrument
2 Explain the operating characteristics and basic electrical circuitry of survey instruments
3 Identify the specific calibration requirements for instruments labeled as "Medical"
4 Describe operational checks on survey instruments
5 Identify conditions that might affect survey instrument response
6 Identify the types of instruments available for performing radiation surveys
7 Identify the instruments types of available for performing contamination surveys
8 Explain the effect of background radiation on the ability to detect low levels of contamination
9 Explain how to obtain and record dose rates from mixed radiation fields
10 Convert meter indications of contamination detection equipment to contamination levels in standard units
11 Explain the operating characteristics and basic electrical circuitry of counting and spectroscopy equipment (such as proportional counters, liquid scintillation detectors, high-purity germanium, zinc sulfide detectors)
12 Perform and describe operational checks on counting and spectroscopy equipment resolution, source, response and background
13 Identify unusual conditions that might affect counting and spectroscopy equipment response such as high humidity, barometric pressure, abnormal background, electronic noise and extreme temperature
14 Explain the operating characteristics and use of radiological survey and analysis instruments
15 Identify unusual conditions that might affect radiation monitoring systems response such as high humidity, barometric pressure, abnormal background, mixed radiation fields and temperature
16 Explain the operating characteristics and use of monitoring devices including the following monitors: area radiation, automatic tool, continuous air, hand and foot,- iodine air, noble gas air, particulate air, personnel whole-body contamination, portable area radiation, portal
17 Describe identifying isotopes and quantifying radioactivity present in samples
18 List the advantages of liquid scintillation counting
19 Describe the composition and use of each component of a liquid scintillation cocktail
20 Describe the operation of a liquid scintillation counter
21 Describe the function of each component of a liquid scintillation system
22 Discuss the problems associated with liquid scintillation counting
23 Apply the basic principles of single channel analyzer systems and component knowledge to identify and quantity unknown radiation sources
24 List the advantages of a proportional counter
25 Identify the factors that affect the operator's selection of a portable air sampler

26 Identify the physical and operating characteristics and the limitation(s) of portable air samplers

27 List the steps for a preoperational checkout of a portable air sampler

28 Identify the physical and operational characteristics and the limitation(s) of beta-gamma constant air monitors (CAMs)

29 Identify the physical and operating characteristics and the limitation(s) of alpha constant air monitors (CAMs)

30 Convert detection equipment indications to airborne radioactivity in standard units (µCi/cm3) and in derived air concentration, to specific activity (µCI/ml) for liquid samples , or to specific activity (µCi/g) for solid samples

31 Define geotropism