# RADIOLOGICAL FIELD OPERATIONS PERSONNEL

# QUALIFICATION/TRAINING PROGRAM

# OYSTER CREEK

# DECEMBER 1981

# Radiological Field Operations Personnel Qualification/Training Program

The purpose of this program is to establish qualification standards for Radiological Control technicians and Radiological Control Foreman at Three Mile Island and Radiological Control technicians and Radiological Control Group Supervisors at Oyster Creek. This program includes the minimum theoretical and practical ability requirements to ensure that those personnel assigned to the Radiological Field Operations Department understand their general and specific radiological duties. The theoretical and practical ability requirements are attached as Appendices A and B respectively.

Contractor personnel are used to fulfill manpower needs during periods of fluctuating radiological workloads. Contractor personnel are required to meet the same training requirements as Company personnel. Contractor personnel may be exempted from the entire training program provided that:

1. Their services are performed as defined by the Manager Radiological Field Operations or his designee, and:

2. They receive training in procedures applicable to their specific duties.

The training program consists of initial training of selected Radiological Control Technicians and a cyclic training program for all Technicians, Foreman and Group Supervisors. The cyclic training material is based upon but is not limited to:

1. Areas where weaknesses in performance have been noted.

2. Areas where regulations and/or procedures have changed.

3. Areas where increased depth in academic understanding will improve performance.

4. Areas where requalification training requirements exist.

Written qualification and where applicable requalification examinations will be administered for all levels. The written examinations will be used to evaluate an individuals ability to meet objectives following the completion of formal classroom training. Oral Board examinations will also be given as a means of determining their ability to respond to unusual radiological situations. The pass/fail criteria used in conjunction with the written and oral examinations are contained in

the Station Procedures covering the qualification and training of Radiological Field Operations Personnel.

The Practical Factors portion of the training program is administered through the use of Practical Factors Worksheets which contain materials outlined in Appendix "B" attached. Each item on the Practical Factors Worksheet shall be completed as an actual task unless approved otherwise by the Manager, Radiological Field Operations or his designee. Radiological Field Operations personnel will be restricted to performing, unsupervised, only those tasks for which the Practical Factors Worksheets have been signed as approved.

Written qualification/requalification examinations shall be administered and corrected by the Radiological Training Department. Oral Board examinations shall be administered by management personnel designated in writing as approved examiners by the Manager, Radiological Controls or the Radiological Controls Director.

The following training records shall be maintained by the Radiological Training Department.

1. All final written qualification/requalification examinations.

2. A summary statement of the individual's performance in oral board examinations, including the areas covered by the examination.

3. All Completed Practical Factors Worksheets.

4. A Certificate of Qualification signed by the Manager, Radiological Controls or the Radiological Controls Director.

5. Records of qualification of Contractor personnel temporarily employed in Radiological Field Operations.

The following training records shall be maintained by the Training Department:

1. Certificates of Qualification.

2. Summary records of all training received along with achievement levels on Radiological Field Operations personnel.

# APPENDIX A

This appendix sets forth the minimum theoretical and practical ability requirements for the training of Radiological Field Operations technicians and foremen/group supervisors.

A. Radiological Fundamentals

1. Radiation and Radioactivity

a. Natural background radiation
b. Types of radiation
   (1) Charge and mass
   (2) Penetrating power
   (3) Sources
   (4) Attenuation
   (5) Methods of interaction
c. Ionization and the rem
   (1) Ionization
   (2) Rad, roentgen, quality factors (coulomb per kilogram)
   (3) Rem - definition and units
d. Curie
   (1) Definition, units
   (2) Sub-units conversions
   (3) Curie/dose rate relationships
e. Dose, dose rate, mixed radiation field dose calculations
f. Radioactive decay
   (1) Decay constants and half-life
   (2) Calculations/determinations
   (3) Biological and effective half-life
   (4) Airborne radioactivity equilibrium calculations

2. Biological Effects of Ionizing Radiation

a. Effect of radiation on human tissue
b. Effect of acute and chronic doses on man
c. Somatic and genetic effects of small doses on population
d. Whole body limits for penetrating radiation
e. Relative risk of radiation exposure
f. Internal exposure
   (1) Sources
      (a) Inhalation
      (b) Ingestion
      (c) Imbedding
      (d) Adsorption
   (2) Critical organs

(3) Body burden and body burden limits
(4) Radionuclides of concern
(5) Derivation of limits
(6) Doses from internal radioactivity
(a) Calculation of dose
(b) Biological effects
(7) MPC hours - derivation and use

g. Biological risks of radiation exposure to unborn child

3. Radiation and Shielding

a. Effect of shielding (e.g., tenth value or half-value thickness)
b. Shielding attenuation values for different types of radiation ($\alpha, \beta, \gamma, n$) and energies
(1) Lead
(2) Steel
(3) Water
(4) Polyethylene
(5) Concretes

4. Radiation Sources

a. Reactor and reactor system sources (fission and activation)
(1) Operations - isotopes, dose rates
(2) Maintenance - isotopes, dose rates
b. Corrosion products
(1) Crud traps
(2) Hot spots
(3) Beta dose during maintenance
c. Concept of buildup factors
d. Dose rate calculations involving time, distance, and shielding for:
(1) Point sources
(2) Line sources
(3) Cylindrical sources - thumb rules
(4) Plane sources - thumb rules
e. Shielding designs and materials in use at facility
f. Function and use of temporary shielding to reduce exposure during maintenance and operations
g. Airborne gaseous and particulate
(1) Radionuclides
(2) Limits
(3) Detection and identification

5. Radiation Detection

a. General principles of operation
(1) Scintillation detectors
(2) Dosimetry equipment

(3) Neutron detection instruments
(4) Gas ionization detectors
    (a) Ionization chambers
    (b) Proportional counters
    (c) Geiger-Mueller counters
(5) Solid state applications

b. For each type of portable radiation and radioactivity survey instrument, and semi-portable and fixed instruments (including Constant Air Monitors, Area Radiation Monitors, and effluent and process monitors), in use at the facility:
(1) Type of detection
(2) Conversion of meter readings to appropriate units
(3) Application of appropriate "thumb rules"
(4) Minimum sensitivity/lower limit of sensitivity
(5) Range, scale, and limits of use
(6) Effects of other types of radiation on indication
(7) Proper field use (e.g., directional, head phones, beta shields)
(8) Calibration and repair requirements
(9) Method of source checking and response checking
(10) Physical checks prior to use
(11) Additional factors (e.g., beta factor, directional meter)
(12) Normal background

6. Counting Statistics

a. Basic principles
b. Basic counting formula
c. Minimum detectable activity
d. Background - effects on results
e. Description, setup, use of equipment, and application of statistics for counting equipment in use at facility

B. Functional Knowledge and Abilities

1. Surveys - radiation, contamination, airborne radioactivity
a. Reasons for surveys and their applications
b. Frequency of required surveys (alpha, beta, gamma, and neutron)
c. Procedures for surveys
d. Survey techniques
e. Proper logging and documentation of results
f. Review and interpretation of results

(1) Normal levels/abnormal levels
(2) Expected results
(3) Trends and trend analysis
(4) Actions if limits are approached or exceeded

g. Routine surveys of representative areas of the facility and proper logging of results
h. Determination of radionuclide type and estimates of activity levels which can result from various incidents (e.g., spills, venting, discharge)

2. Facility Design, Systems, and Components

a. Radioactive systems (e.g., charging/discharge)
b. Auxiliary systems (e.g., ventilation, radioactive waste processing, radiation monitors)
c. System interfaces
d. Integrated plant operations (e.g., discharge, venting)
e. Plant emergency shutdown systems (e.g., ventilating, RHR, ECCS, radioactive waste, containment isolation)

3. Contamination Control and Decontamination

a. Definition of contamination
(1) Loose contamination
(2) Fixed contamination
(3) Limits for loose and fixed alpha, beta, and beta-gamma
(4) Sources of contamination areas

b. Controlled surface contamination areas
(1) Work area preparation, isolation, and posting
(2) Set-up and operation of an access control point
(3) Requirements for area entry
(4) Radiation work practices
(a) Prevention of equipment contamination
(b) Transfer of items to clean area
(c) Area work habits
(5) Controls and monitoring required for contaminated filter removal from radioactive liquid systems, ventilation systems, and vacuum cleaners
(6) Personnel surveys (frisking)
(7) Requirements for entry into high radiation areas/controlled surface contamination areas
(8) Procedures and reasons for each step and technique in the above items
(9) Methods of controlling internal contamination

c. Contamination/airborne radioactivity survey technique

(1) Swipes/air samples
  (a) Calculation of results for fixed area (e.g., 100 $cm^2$, 1 $m^2$) or volume (e.g., portable air samples of 3 $m^3$ 1 $m^3$)
  (b) Calculation of results for large area swipes or high volume air samples
  (c) Techniques
  (d) Conversion factors and activity calculations
  (e) Thumb rules for swipes and air samples
(2) Thumb rules for contamination level/dose rate conversions for meters in use
(3) Personnel survey techniques
  (a) Detection of internal radioactivity
  (b) Detection of external radioactivity (alpha, beta, gamma)

d. Anticontamination clothing
  (1) Proper procedures for donning and removing a complete set
  (2) Proper wearing and removing dosimetry equipment with anti-C clothing
  (3) Conditions and requirements for wearing anti-C clothing
  (4) Used anti-C control

e. Respiratory protection
  (1) Proper procedures for donning, using, and removing respiratory protection equipment
  (2) Conditions and requirements for donning respiratory protection equipment; protection factors
  (3) Control of work to eliminate the need for respiratory equipment
  (4) Regulatory Guide 8.15/NUREG-0041 requirements and compliance
  (5) Use of MPC hours

f. Contamination containment areas
  (1) Construction and use of containment areas, disposable glove boxes, tents, etc.
  (2) Verification of proper construction and set up, testing, and removal of containment areas
  (3) Corrective actions for leaks, tears, flooding

g. Routine systems operations
  (1) Valve disassembly
  (2) Venting and draining radioactive systems
  (3) Welding, grinding, and cutting radioactive pipe
  (4) Proper use of portable HEPA ventilation systems

h. Decontamination
   (1) Techniques for decon and waste handling
   (2) Standards applicable to reactor systems components
   (3) Techniques and procedures for limiting contamination spread and reducing exposure
   (4) Personnel decontamination
      (a) Basic skin decontamination techniques (simulated)
      (b) Evaluation of effectiveness/documentation of results

4. Radioactive Material Control

   a. Procedures and records for radioactive material control
      (1) Control and tracking
      (2) Shipment and receipt (facility procedures and DOT requirements)
      (3) Storage - environmental and fire protection, dose reduction
   b. Identification of radioactive materials
      (1) Definitions - Federal/licensee
      (2) Surveys and estimates of radioactivity and contamination levels (e.g., valves, liquid, drums)
      (3) Physical identification
      (4) Criteria for liquids, solids with trace levels of radioactivity
      (5) Facility and DOT standards
   c. Control of standard radioactive sources (e.g., instrument sources, check sources)
   d. Control of source material, fissile, and special nuclear material
   e. Procedures in event of loss of radioactive materials
   f. Solid waste compactor radiological controls

5. Dose Limits and Controls

   a. Federal limits and licensee control levels
      (1) Whole body penetrating radiation
      (2) Skin, forearms, extremities
      (3) Internal organs
   b. Use and reasons for limits
   c. Effects and exposures resulting from types of radiation
   d. Emergency exposure guidelines
   e. Stay time calculations involving extremity and whole body dose rate

f. Definitions, controls, and requirements for access for:
   (1) Restricted areas
   (2) Radiation area
   (3) High radiation area
   (4) Exclusion area
   (5) Hot spots
   (6) Wait area
g. Controls for preventing personnel from exceeding licensee control levels and dose limits
h. Actions for individual dose exceeding internal, external, or skin contamination limits
i. Practical dose control
   (1) For work in moderate general area dose rates (e.g., 100-200 mrem/hr.)
   (2) For high radiation area work in the vicinity of hot spots
j. ALARA applications for dose reduction (Regulatory Guides 8.8, 8.10)
k. Field dose control actions for
   (1) Individual with lost or off-scale pocket dosimeter
   (2) Lost or damaged personnel monitoring device
l. Limits for release of radioactive or contaminated material from controlled surface contamination or restricted areas

6. Radioactive Waste Control

a. Classifications
   (1) High/low levels
   (2) Baleable and non-baleable
   (3) Liquid/solid/gas
b. Proper waste disposal
   (1) Segregation of waste
   (2) Survey and release of materials
c. Techniques for waste control and volume reduction
d. Potential effects of uncontrolled discharges
e. Controls for replacement of radioactive filters or resins
f. Radwaste systems operations

7. Environmental Monitoring
   a. Reasons for environmental monitoring
   b. Results of program
   c. General techniques (e.g., for emergency monitoring)

8. Counting Systems

   a. Type of samples counted
   b. Preparation for counting/equipment setups
   c. Sample counting procedures
   d. Documentation and reporting of results
   e. Actions for high or unusual results

9. Incident and Unusual Event Control

   a. General incident analysis techniques
      (1) Evaluation of initial symptoms
      (2) Immediate actions
      (3) Supplemental actions
      (4) Analysis/problem identification
   b. Symptoms of postulated accidents
      (1) Major reactor accidents
      (2) Primary to atmosphere leaks
      (3) Primary to secondary system (e.g., PWR steam generator) leaks
   c. Control and corrective actions for major and minor categories of:
      (1) Radioactive spill (liquid or dry)
      (2) High airborne radioactivity (particulate and gaseous)
      (3) Contaminated, injured person
      (4) High radiation levels
   d. Relative to above events
      (1) Reasons for actions taken
      (2) Radiological problems resulting
         (a) Dose
         (b) Dose rates
         (c) Activity concentrations
         (d) Radionuclides of concern
      (3) Possible causes
      (4) Consequences of improper actions
   e. Radiation incident knowledge
      (1) Recent local events
      (2) Generic power reactor experiences
   f. Emergency Plan - Training and Drills
      (1) Technician assignments and responsibilities
      (2) Walk-through training
      (3) Drills

g. Post-accident sampling and analysis
   (1) Access/work control
   (2) Exposure reduction
   (3) Sources of radiation/exposure
      (a) Gaseous radioactivity
      (b) Particulate radioactivity
      (c) Source terms (e.g., RHR system, ventilation filter, LPCI, etc.)
   (4) Radioiodine
   (5) Emergency sampling and analysis procedures

10. Facility Radiation Protection Program

a. ALARA programs, guidelines, and procedures
b. Facility radiation protection program procedures

c. Federal requirements, regulations, and guidelines (e.g., Regulatory Guides, 10 CFR 19, 10 CFR 20, ANSI)
d. Radiological control organization and reporting
e. Bioassay program
f. Radiation Protection deficiency reporting, follow-up and analysis system
g. Work functions of Radiological Control Technicians/Foreman
   (1) Operations support functions/facility interfaces
   (2) Quality control functions
   (3) Interface with individuals and the public

## APPENDIX B

The following topics are examples of the material covered during the Practical Factors training of various levels of Radiological Field Operations Personnel:

A. Instruments

1. Portable survey instruments
2. Air sampler operations
3. Laboratory counter operations

B. Surveys

1. Contamination surveys
2. Airborne radioactivity surveys
3. Radiation surveys
4. Shipment of radioactive material
5. Biological Shielding
6. Reactor Entry
7. Reactor Shutdown

C. Duties

1. Control point watch
2. Issue and field leak check respirators - TMI only
3. Demonstrate proper use of protective clothing and respirators
4. Completion of Radiation Work Permits
5. Posting Radiation Areas
6. Area isolation and preparation
7. Radiological controls job coverage
8. Issue and terminate Radiation Work Permits
9. Evaluation of potential beta radiation hazards
10. Investigation and documentation of Radiological Incidents
11. Emergency equipment survey
12. General on the job training
13. Review of Radiation Work Permits
14. Maintain Radiological Control Log Books
15. Conduct ALARA reviews
16. Review duties of Radiological Assessment Coordinator
17. Review functions of Radiological Control Coordinator
18. Review Emergency Kit inventories

D. Emergency Response

1. Corrective actions in emergency situations

2. Demonstrate proper use of on-site/off-site Emergency Kits
3. Demonstrate knowledge of the Emergency Plan

E. Indoctrination on Responsibilities in the Following Areas:

1. Radiological Assessment Coordinator
2. Radiological Controls Coordinator

3. Department Administration