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New Mexico Junior College

Radiological Control and Waste Handling

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1. Approved Program Radiological Control & Waste Handling

1.0 Summary

The program proposal for the Certificates and Associate’s Degree of Applied Science in Radiological Control and Waste Handling was approved by the New Mexico Junior College Board in October of 2002. Further information about the degree plans is found in section 3 within this document. A summarized table for the degree plan is shown in table 3.1, page 6. A more detailed description of the certificates and degree plan are described on page 7, 8, and 9.

The program includes 7 new core classes evaluated and recommended by the curriculum committee in September of 2002. All course revisions are listed in greater detail in section 4.1 - 4.7 on page 10 through 16. A summarized table (table 1.0) is a quick overview of the proposed core classes in the curriculum.

Table 1.0 Program / Course Revision

<table>
<thead>
<tr>
<th>Course Prefix and Course Number</th>
<th>Proposed Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW 113</td>
<td>Introduction to Radiological Control and Waste Handling</td>
<td>Lecture 3</td>
</tr>
<tr>
<td>RW 123</td>
<td>Fundamentals of Radiation Control</td>
<td>3</td>
</tr>
<tr>
<td>RW 133</td>
<td>Standards &amp; Theory of Radiological Control</td>
<td>3</td>
</tr>
<tr>
<td>RW 213</td>
<td>Radiological Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>RW 214</td>
<td>Radiological Monitoring &amp; Protection</td>
<td>3</td>
</tr>
<tr>
<td>RW 223</td>
<td>Radiological Transportation &amp; Emergencies</td>
<td>3</td>
</tr>
<tr>
<td>RW 224</td>
<td>Radiological Instrumentation</td>
<td>3</td>
</tr>
</tbody>
</table>
Competencies for the program are summarized and further discussed in detail in section 2.

1.1 Program Development and Results

The program is a result of a grant given by Westinghouse TRU Solutions together with the Department in Energy of September 2001. The purpose of the grant is to establish a program for training Radiological Control Technicians for future employment at the Waste Isolation Pilot Plant (WIPP) in Eddy County. The Program Director was hired in June of 2002 and the first class offered as a Special Topics Course, RW 193, on August 19, 2002. Enrollment in the first class numbered 27 students of which 12 students were from Carlsbad and the remainder from Hobbs. A total number of 43 has completed through one or more classes in the two semesters the program has been offered. Many had as a goal to complete the short course. Their goals were researched upon entering class by the Director to better measure the success of the program. Of the 43 students, 24 students continued the program with another class in Radiation Protection. The curriculum comprised of the CL100 DOE series was completed by 19 students and finally of those 19, 6 continued and completed the Certificate of Completion (18 hrs). Of those 6, 4 obtained work at WIPP.

The degree plan and competencies are based on standards and guidelines from the Department of Energy. An effort has been made to ensure a standardized curriculum to open the program for employer’s on a national scale. In addition valuable input has been given by the training department at WIPP, with new and revised material.

The next step in our program development is further recruiting and the design and creation of a laboratory for training in instrumentation and radiation practices. Currently a collaboration with WIPP has allowed the Program Director to spend time at WIPP to observe the process and share information and assist workers with educational concerns.

1.2 Goals

The program seeks to educate Radiological Control Technicians (RCTs) for work in the Nuclear Industry. The program seeks to adhere to standards and guidelines from the Department of Energy for Radiological Control Technicians. The program is currently satisfying the needs for the WIPP site in Carlsbad. Many of the students have been called to an interview and two has been hired.
We seek to expand our area to cover the need for RCTs on an inter-state level. Target employers are Pantex in Amarillo, Waste Control Specialists in Eunice, Sandia National Laboratories, and Los Alamos National Laboratories. Furthermore, by adhering to national standards, we are planning to expand the program to a national level. Work is now done to create the internet classes necessary to service these areas.

The market for short courses and industry training has potential. Several private companies are serving the current needs of the nuclear industry. Our target students are full-time and part-time students at this institution as well as students in other parts of the country utilizing Internet learning.

1. 3 Course Requirements

The course requirements for the certificates and the degree are listed in table 3.1 on page 6. The table is a summary of the Radiological Control and Waste Handling Program.

1. 4 Outlook for Radiological Control Technician.

Radiological Control Technicians work closely with other radiological control and waste handling team members through the use of instrumentation and other procedures. New Mexico with its National Laboratories and possible future nuclear facilities, like an Uranium Enrichment Plants or Plutonium Trigger Facility. Students in the science of Radiological Control and Waste Handling will meet education requirements through a comprehensive educational program consisting of classroom, laboratory, and/or remote Internet television classes. Employment opportunities include radioactive waste isolation and handling plants, nuclear power plants, and public and private research laboratories.

1. 5 Definition of a DOE Certified Radiological Control Technician.

Radiological Control Technicians work closely with other radiological control and waste handling team members through the use of instrumentation and other procedures. Emphasis is placed on knowledge and application of waste handling practices. Students in the science of Radiological Control and Waste Handling will meet education requirements through a comprehensive educational program consisting of classroom, laboratory, and/or remote Internet television classes. Employment opportunities include radioactive waste isolation and handling plants, nuclear power plants, and public and private research laboratories.

The DOE definition is taken from the Standard of Occupational Radiation Protection, 10 CFR 835. The definition state:
Paragraph 835.903 Radiological Control Technicians.

Training and retraining programs for radiological control technicians shall be established and conducted at intervals not to exceed 2 years to familiarize technicians with the fundamentals of radiation protection and the proper procedures for maintaining exposures ALARA. This program shall include both classroom and applied training. The training shall either precede performance of tasks assigned to radiological control technicians or be concurrent with such task assignments if the individual is accompanied by and under the direct supervision of a trained individual. The required level of knowledge of radiation safety possessed by radiological control technicians shall be verified by examination to include demonstration prior to any unsupervised work assignment. The training program shall include procedures specific to the site or facility where the technician is assigned. The level of training shall be commensurate with the technician's assignment. Allowance may be made for previous DOE training on generic radiation safety topics (i.e., those not specific to a site or facility), provided the training was received within the past 2 years. Documentation of the previous training shall clearly identify the individual's name, date of training, topics covered, and name of the certifying individual.

2.0 Competencies

2.1 Definition of Program Competencies
The purpose of the program competencies, is to strengthen the academic skills through general course requirements at NMJC by enrolling in a broad variety of classes. The competency requirements are defined by the level the student wishes to achieve in addition to the core competencies described in section 2.2. The required classes for each certificate and the associate’s degree are listed in table 3.1, page 6. The program competencies are defined by these general courses in addition to the new core competencies discussed in section 2.2 and 2.3. The general courses are also meant to complement and further the students’ knowledge in the core competencies.

2.2 Definition of Core Competencies
The competencies required for the students enrolled in the program in Radiological Control and Waste Handling are based on DOE Standards and Guidelines as well as input from WIPP Training Department.
2.3 Listing of Core Competency Areas with corresponding classes

Personnel will demonstrate comprehensive knowledge of the core competencies in the following areas in table 2.1 on this page.

Table 2.1 Competency Areas

<table>
<thead>
<tr>
<th>Competency Areas</th>
<th>Corresponding Core Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Basic Mathematics and Algebra</td>
<td>Introduction to Radiological Control and Waste</td>
</tr>
<tr>
<td>2) Unit Analysis &amp; Conversion</td>
<td>Introduction to Radiological Control and Waste</td>
</tr>
<tr>
<td>3) Physical Science</td>
<td>Introduction to Radiological Control and Waste</td>
</tr>
<tr>
<td>4) Nuclear Physics</td>
<td>Introduction to Radiological Control and Waste</td>
</tr>
<tr>
<td>5) Sources of Radiation</td>
<td>Introduction to Radiological Control and Waste</td>
</tr>
<tr>
<td>6) Radioactivity and Radioactive</td>
<td>Fundamentals of Radiation Control</td>
</tr>
<tr>
<td>7) Interaction of Radiation with Matter</td>
<td>Fundamentals of Radiation Control</td>
</tr>
<tr>
<td>8) Biological Effects of Radiation</td>
<td>Fundamentals of Radiation Control</td>
</tr>
<tr>
<td>9) Radiation Protection Standards’</td>
<td>Standards &amp; Theory of Radiological Control</td>
</tr>
<tr>
<td>10) ALARA (As Low As Reasonable)</td>
<td>Standards &amp; Theory of Radiological Control</td>
</tr>
<tr>
<td>11) External Exposure Control</td>
<td>Standards &amp; Theory of Radiological Control</td>
</tr>
<tr>
<td>12) Internal Exposure Control</td>
<td>Standards &amp; Theory of Radiological Control</td>
</tr>
<tr>
<td>13) Radiation Detector Theory</td>
<td>Standards &amp; Theory of Radiological Control</td>
</tr>
<tr>
<td>14) Radiological Documentation</td>
<td>Radiological Control Systems</td>
</tr>
<tr>
<td>15) Communication Systems</td>
<td>Radiological Control Systems</td>
</tr>
<tr>
<td>16) Counting Errors and Statistics</td>
<td>Radiological Control Systems</td>
</tr>
<tr>
<td>17) Dosimetry</td>
<td>Radiological Control Systems</td>
</tr>
<tr>
<td>18) Contamination Control</td>
<td>Radiological Monitoring &amp; Protection</td>
</tr>
</tbody>
</table>
19) Air Sampling Programs/Methods Radiological Monitoring & Protection
20) Respiratory Protection Radiological Monitoring & Protection
21) Radioactive Source Control Radiological Monitoring & Protection
22) Environmental Monitoring Radiological Monitoring & Protection
23) Access Control and Work Area Radiological Monitoring & Protection
24) Radiological Work Coverage Radiological Monitoring & Protection
25) Shipment/Receipt of Radioactive Radiological Transportation & Emergencies
26) Radiological Incidents and Radiological Transportation & Emergencies
27) Personnel Decontamination Radiological Transportation & Emergencies
28) Radiological Considerations for Radiological Transportation & Emergencies
29) Radiation Survey Instrumentation Radiological Instrumentation
30) Contamination Monitoring Radiological Instrumentation
31) Air Sampling Equipment Radiological Instrumentation
32) Counting Room Equipment Radiological Instrumentation

3. Certificate and Associates Degree Program

The course requirements for the certificates and the degree are listed in table 3.1 on this page. The table is an overview of the Radiological Control and Waste Handling Program.

Table 3.1 Course Requirements for Radiological Control and Waste Handling

<table>
<thead>
<tr>
<th>Class</th>
<th>Certificate of Completion 16 - 18 credit hours</th>
<th>Certificate 36 - 38 credit hours</th>
<th>Associate's Degree in Applied Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 110, College Orientation</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PS 112, Freshman Seminar</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>BU 223, Business Communication</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MA 114B, Technical Mathematics</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Additional Mathematics(3)</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>EN 113, Composition &amp; Rhetoric</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>EN 123A, Report Writing for Technicians</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Classes from following prefixes can be used: SE, EC, GO, HI, PI, SO, PS, DR and SP (9)</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Mathematics(3)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Laboratory Science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>Certificate of Completion 16 - 18 credit hours</td>
<td>Certificate 36 - 38 credit hours</td>
<td>Associate's Degree in Applied Science</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------</td>
<td>----------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>(any BI, PH, CH, GE prefix) (4)</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>HM 223, Environmental Health and Safety</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>HM 233, Environmental Law</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>HM 233B, Transportation of Hazardous Materials</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>RW 113, Introduction to Radiological Control &amp; Waste</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RW 123, Fundamentals of Radiation Control</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RW 133, Standards &amp; Theory of Radiological Control</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RW 213, Radiological Control Systems</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RW 214, Radiological Monitoring &amp; Protection</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>RW 223, Radiological Transportation &amp; Emergencies</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RW 224, Radiological Instrumentation</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total Program Credit Hours (Including optional freshman seminar 2 hrs)</td>
<td>18</td>
<td>38</td>
<td>66</td>
</tr>
</tbody>
</table>

### 3.1 16-18 Credit Hours Certificate of Completion

**Certificate of Completion**

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**Radiological Control & Waste Handling Technician**

Requirements: A total of 16-18 credit hours from the following required courses. All courses, other than General Education Requirements, must be completed with a “C” or better.

**General Education Requirements (7-9 credit hours)**
- PS 110, College Orientation (Freshman Seminar may be substituted for PS 110...0-2 hrs.)
- BU 223, Business Communication ................................................................. 3 hrs.
- MA 114B, Technical Mathematics I ................................................................. 4 hrs.
Departmental Requirements (9 credit hours)
  RW 113, Introduction to Radiological Control & Waste Handling .................. 3 hrs.
  RW 123, Fundamentals of Radiation Control .............................................. 3 hrs.
  RW 133, Standards & Theory of Radiological Control .................................. 3 hrs.

Total ........................................................................................................................................... 16-18 hrs.

NOTE: This program incorporates fundamentals important to obtain employment upon graduation. It may not be suitable if used as a transfer to institutions of higher learning.

3.2 36-38 Credit Hours Certificate

Certificate
Radiological Control & Waste Handling Technician

Requirements: A total of 36-38 credit hours from the following required courses. All courses, other than General Education Requirements, must be completed with a “C” or better.

General Education Requirements (13-15 credit hours)
  PS 110, College Orientation (Freshman Seminar may be substituted for PS 110) .... 0-2 hrs.
  EN 113, Composition & Rhetoric .............................................................................. 3 hrs.
  BU 223, Business Communication .......................................................................... 3 hrs.
  MA 114B, Technical Mathematics I ............................................................................ 4 hrs.
  Math (MA prefix) ............................................................................................................ 3 hrs.

Departmental Requirements (23 credit hours)
  RW 113 Introduction to Radiological Control & Waste Handling .................. 3 hrs.
  RW 123 Fundamentals of Radiation Control ............................................................. 3 hrs.
RW 133 Standards & Theory of Radiological Control......................................................3 hrs.
RW 213 Radiological Control Systems..............................................................................3 hrs.
RW 214 Radiological Monitoring & Protection......................................................................4 hrs.
RW 223 Radiological Transportation & Emergencies......................................................3 hrs.
RW 224 Radiological Instrumentation.................................................................................4 hrs.

Total........................................................................................................................................36-38 hrs.

NOTE: This program incorporates fundamentals important to obtain employment upon graduation. It may not be suitable if used as a transfer to institutions of higher learning.

### 3.3 Associate of Applied Science in Radiological Control & Waste Handling

**Associate of Applied Science**

**Radiological Control & Waste Handling Technician**

A total of 64-66 credit hours of which at least 12 hours are earned at NMJC; minimum GPA of 2.0. All courses, other than General Education Requirements, must be completed with a “C” or better.

**General Education Requirements (23-25 credit hours)**

- PS 110, College Orientation (Freshman Seminar may be substituted for PS 110)........0-2 hrs.
- EN 113, Composition & Rhetoric......................................................................................3 hrs.
- EN 123A, Report Writing for Technicians.........................................................................3 hrs.
- BU 223, Business Communication.....................................................................................3 hrs.
- Math (MA prefix)..................................................................................................................6 hrs.
- Laboratory Science (any BI, PH, CH, GE prefix).................................................................4 hrs.

**Non-Departmental Requirements (9 credit hours)**

Department of Radiological Control & Waste Handling
Classes from the following prefixes can be used to satisfy the Radiological Control and Waste Handling requirement: SE, EC, EN, GG, GO, HI, PI, SO, PS, DR, MU, AR and SP.................................................................9 hrs.

Departmental Requirements (32 credit hours)

- RW 113, Introduction to Radiological Control & Waste Handling...............3 hrs.
- RW 123, Fundamentals of Radiation Control..............................................3 hrs.
- RW 133, Standards & Theory of Radiological Control...............................3 hrs.
- RW 213, Radiological Control Systems......................................................3 hrs.
- RW 214, Radiological Monitoring & Protection.........................................4 hrs.
- RW 223, Radiological Transportation & Emergencies............................3 hrs.
- RW 224, Radiological Instrumentation......................................................4 hrs.
- HM 223, Environmental Health & Safety (OSHA)Technology..................3 hrs.
- HM 233, Environmental Law.................................................................3 hrs.

Total.................................................................64-66 hrs.

NOTE: This program incorporates fundamentals important to obtain employment upon graduation. It may not be suitable if used as to transfer to other institutions of higher learning.

4.1 Introduction to Radiological Control and Waste Handling
In this course students will be introduced to Radiological Control and Waste Handling. This course offers study of the fundamentals that are required by many employers in the nuclear industry. Coverage will include foundations in basic mathematics, physics, biology, chemistry, and studies of sources of radiation. Three lecture hours per week. Prerequisites: None

4.2 Fundamentals of Radiation Control
In this course students will be introduced to fundamentals of radiological control and waste handling. Coverage includes the fundamentals of radioactivity and radioactive decay. Characteristics of alpha, beta and gamma radiation are introduced, using equations of radioactive decay; identifying alpha, beta, positron decay, and electron capture. Differences between natural and artificial radioactivity and unstable fission products will also be taught. The elements of the Chart of Nuclides, half life, specific activity, and units are also introduced. Three lecture hours per week. Prerequisites: None.

4.3 Standards & Theory of Radiological Control
In this course students will be introduced to standards and theory of radiological control. Coverage will include radiological protection standards, the ALARA Principle, external and internal exposure control, and radiation detector theory.
Standards and principles of protection and the proper detecting and handling of radioactive matter is taught. Calculations of internal and external exposure are covered extensively. Basic theory, identifying how to measure radioactivity, together with practical tasks including instrumentation, is also taught. Three lecture hours per week. Prerequisites: None.

4.4 Radiological Control Systems
In this course students will be introduced to systems used to control radiological events. Coverage will include the documentation process, communication systems, counting errors and statistics, and dosimetry. The understanding of the requirements of documentation and communication systems as defined by the Department of Energy is emphasized. Reporting this data in a correct manner is a core element of the course. The ways of calculating exposure limit through dosimetry practices are also taught. Three lecture hours per week. Prerequisites: None.

4.5 Radiological Monitoring & Protection
In this course students will be introduced to contamination control and monitoring in a radiological work setting. This course covers contamination control, airborne sampling, respiratory protection, radioactive source control, environmental monitoring, access control, work area setup, and radiological work coverage. The proper handling of radioactive materials is a key element of the course. Three lecture hours and three lab hours per week. Prerequisites: RW 113, and RW 213 or consent of instructor.

4.6 Radiological Transportation & Emergencies
In this course students will be introduced to the proper procedures for shipping and receiving radioactive material. Department of Energy and Department of Transportation guidelines will be taught. Processes related to radiological incidents and emergencies, personnel decontamination, and radiological considerations for first aid will also be covered. Training in instrumentation used in monitoring radioactivity is an important component of the course. Three lecture hours per week. Prerequisites: RW 113 or consent of instructor.

4.7 Radiological Instrumentation
In this course students learn to use the most common types of radiation monitoring and sampling equipment, through hands on training. Contamination monitoring instrumentation, and air sampling and counting room equipment are emphasized. Three lecture hours and three lab hours per week. Prerequisites: RW 214.