– APPENDICES TO THE –

ALIGNMENT BETWEEN THREE ENERGY OCCUPATIONS AND MILITARY OCCUPATIONS PROOF OF CONCEPT REPORT

DECEMBER 2014

Report appendices prepared by Solutions for Information Design, LLC
under contract to National Institute of Building Sciences

Solutions for Information Design, LLC

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APPENDIX A: PROFESSIONAL TESTING SCHEME COMMITTEE MEETING SUMMARY – BUILDING OPERATIONS PROFESSIONAL

Professional Testing

Meeting Summary

Client	U.S. Department of Energy (DoE) National Institute of Building Sciences (NIBS)
Date	August 21 - 22, 2014
Location	Professional Testing Denver Office
Objective	Determine Scheme Committee Requirements for Building Operations Professional
Participants	Terry Bickham Robert Blakey James Coates Rick Dames Paul Ehrlich David Hewett David Redding Teresa Rodgers Rodney Schauf Daniel Sexton (absent) Neil Morgan (stand in for Daniel Sexton)
NIBS Project Manager	Deke Smith, Executive Director, building **SMART** alliance and Program Director, Commercial Workforce Credentialing Council
Professional Testing Facilitator	Dr. Christine Niero, Facilitator Vice President, Professional Testing, Inc.
Observer	Leen Zaballero, Penn State University Rachel Romero, NREL
Purpose	To determine scheme requirements for the Building Operations Professional in conformity with ISO/IEC 17024:2012 Accreditation Requirements

Summary of Discussion

Dr. Niero of Professional Testing, Inc. began the meeting with welcoming address and introductions. Dr. Niero explained the purpose of the meeting and provided an overview of the certification program activities that had occurred thus far in the development of a certification examination for the Building Operations Professional.

Overview of ISO/IEC 17024 and Certification

Dr. Niero then gave a brief overview of scheme requirements of ISO/IEC 17024 *Conformity assessment– general requirements for bodies operating certification of persons* as administered by the American National Standards Institute (ANSI), noting that the certification programs sponsored by DoE and NIBS were to conform to these accreditation standards.

Report of the Building Operations Professional Validation Survey

Dr. Niero provided an overview of the Job Task Analysis process for the Building Operations Professional conducted February 10 – 12, 2014 and reported the demographic findings of the validation survey, including: highest level of education; years of energy experience; years of experience as a Building Operations Professional, state and sector in which respondents work. The demographic data was presented to provide a profile of job incumbents in building operations. Dr. Niero then provided an overview of the Examination Blueprint and the DACUM chart of duties and tasks; knowledge, skills, abilities and attributes; tools, equipment and resources to orient the task force participants about the job building operations professionals perform, and the foundation for the certification examination.

Work of the Scheme Committee

Task force participants were provided a copy of the JTA Report and the DACUM chart for review and reference. As a group of the whole, task force participants began to discuss the requirements for certification, including eligibility to qualify for the exam, at a high level, answering the question "What does the building operations professional" look like in terms of experience, education, and other work-related experiences. The group agreed that the Building Operations Professional is a senior-level position (the role was referenced as the "Chief Engineer"). Once the group identified broad parameters for certification and eligibility, they broke into three work groups to accomplish the following:

1. Draft requirements for certification based on the competencies, identifying tasks that can be assessed on a written exam, and those that can't be tested but candidates need to present with to earn the certification
2. Draft eligibility requirements for their respective work group category
3. Determine equivalencies where possible for degree and work-related experiences, including military experience
4. Provide definitions and parameters for each requirement so the applicant can easily understand the requirement
5. Determine how information can be documented on an application
6. List supporting documentation provided with submission of the application.

Participants were instructed to:

1. Ask "why" have the requirement(s)

2. Ask "what" assurances the requirement(s) provides for establishing eligibility, and to consider aspects of "fairness" to applicants
3. Ask "what" assurances the requirement(s) provides to matters such as safety, ethics, etc.
4. Ask "what" documentation would be required to demonstrate an applicant meets the requirement(s)
5. Ask what level of "trust" and degree of "confidence" the requirement provides that supports the ability of the building operations professional to perform their job
6. Ask "what" the eligibility requirement or certification requirement assures that the exam cannot test.

Once participants completed the group activities, the groups reported their recommendations for eligibility and the rationale to support specific requirements. Once all presentations were made, the full group discussed each requirement and arrived at the final set of eligibility requirements.

The following requirements for certification were agreed upon by the group:

Eligibility Requirements to quality for the Building Operations Professional ce rtification examination

The Scheme Committee reviewed the DACUM charts task by task, and identified the tasks and associated KSAs that could be tested, and those that could be verified through experience or other requirements. The following eligibility requirements were agreed upon.

Participation in facility energy assessment OR 30 contact hours of specific relevant training in energy assessments, system optimization, measurement verification and energy analysis; plus participation in capital planning process, OR 10 contact hours of specific relevant training in capital budget, equipment, lifecycle analysis (LCA).

Participation in a minimum of three projects related to facility operations, improvements, or repairs spanning submittal approval, construction planning, completion verification, and commissioning as appropriate to the project. Over the three projects, the applicant must have performed the following activities at least once: conduct equipment inventories; identify equipment specifications; identify O&M requirements; rank equipment in terms of priority; determine level of service to be performed on equipment based on criticality of system; identify tasks to be outsourced; identify skill level of staff; identify required tools; identify opportunities for predictive maintenance.

Over the course of a minimum of three engagements with third-party or external resources, the applicant must have done each of the following activities at least once: create the RFP and SOW; determine requirements for outside services; determine type of contract; interview service providers; review proposals or RFP responses; develop or use existing contractor/service provider handbook; conduct orientation for service providers; determine criteria for selection of service providers; secure the services of outside service providers.

AND One of the following options:

1. High School Diploma or GED with 10 years' experience in building operations* with a minimum of 3 years in supervisory role**.

2. Associate/Technical/Vocational 2 year degree, or equivalent military training, with 8 years' experience in building operations with a minimum of 3 years in supervisory role.

3. Associate Degree or Vocational degree related to Building Operations with 7 years' experience in building operations with a minimum of 3 years in supervisory role. Building Operations related degrees include courses, for example, but not limited to: HVAC, energy management, mechanical engineering, electrical engineering, boilers, fans and pumps, building automation technology, fire-life safety, lighting, sustainability, green technology, etc.

4. Bachelor's Degree or higher or attainment of E6 in any branch of the military with 6 years' experience in building operations with a minimum of 3 years in supervisory role.

5. Bachelor's Degree or higher related to Building Operations or attainment of E6 in a related specialty in a branch of the military with 5 years' experience in building operations with a minimum of 3 years in supervisory role. Building Operations related degrees include courses, for example, but not limited to: HVAC, energy management, mechanical engineering, electrical engineering, boilers, fans and pumps, building automation technology, fire-life safety, lighting, sustainability, green technology, etc.

*Experience in building operations is defined as performing general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity and safety of the building occupants.
**Supervisory experience is defined as directing, planning and evaluating individuals responsible for performing general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity and safety of the building occupants.

Recertification Requirements for the Building Operations Professional

Dr. Niero provided an overview of the purposes of recertification, and a summary of the requirements for Building Operations Professional. The three year recertification cycle was determined, with 50 points required for recertification utilizing the formula of 1 point = 1 hour of activity, unless stated otherwise. The following requirements for recertification were determined. Alignment with competency requirements was determined. Individuals applying for recertification must meet the current requirements and agree to abide by all policies.

The following requirements were determined, which must align with the competency requirements of the certification (exam blueprint).

Recertification Options: 50 points must be earned from the following options, or combination of options.

Work in the field: 10 points shall be awarded for each year of full-time employment as a Building Operations Professional or as an instructor in an accredited institution and/or program for a maximum of up to 30 points.

Continuing Education (CE): CE is a process used by certified persons to maintain and advance their competency. Maximum of 30 points may be earned in this option. CE includes education/training received and education/training given and may be obtained from several sources, including:

- Webinars—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentation.
- Conference Presentation—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations
- Workshops—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations
- College Credit (traditional or online)—10 points per college credit
- Training online or in person—1 point per hour of attendance; 2 points per hour as a presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations

Regulatory work: Participation in development or maintenance of regulatory standards. Participation includes attending meetings, official review, appointment as a committee member. Includes regulatory compliance analysis and support lent to legislation/regulation for support of building operations professionals (not lobbying)—up to 20 points

Retesting: Meet the current qualifications for and pass the certification exam: 50 points

Publications: Must be related to the industry, which is defined as building systems technology and operations. Up to 20 points—points are awarded per publication as follows:

- Published conference or technical paper; must be peer reviewed and published—10 points
- Providing a review of conference or technical paper; electronic or written confirmation of completed review—1 point
- Author a book, manual or guideline that is published. Credit is awarded at the time of publication—20 points
- Journal, bulletin, or magazine article—10 points for peer reviewed; 5 points for non-peer reviewed

Whitepaper or position paper; may be digitally published and distributed. Provide documentation of delivery method—5 points

Author or co-author for chapter of technical handbook; credit is awarded when published—2 points

Review of a technical handbook chapter; credit is awarded when review is completed—1 point.

Code of Ethics

Dr. Niero provided an overview of the purposes of the Code of Ethics and the disciplinary program for certified individuals. The following Code of Ethics was adopted. The following types of sanctions were approved.

Cease and Desist
Written reprimand
Written reprimand with remediation
Censure
Suspension
Revocation
Permanent revocation

In addition to imposing sanctions, certification bodies shall have the authority to report sanctions to legal and regulatory authorities, and other credentialing organizations as appropriate.

Alignment of scheme requirements with assessment methodology

Dr. Niero provided an overview of the scheme requirements with the assessment methodology to identify any competency requirements not being assessed, and for determining alternative methods of assessment, if appropriate and necessary. It was determined that the competency requirements are assessed through the eligibility criteria and examination.

Next steps

1. Conduct a review across all schemes to assure consistency in determining requirements for applicants from the military.
2. Review any changes to the Code of Ethics other scheme committees may make, and approve one Code of Ethics for all four certifications.
3. Vote to adopt the scheme.
4. Present scheme to the CWCC Board of Advisors and the Board of Direction.
5. Recommend to the National Institute of Building Sciences (NIBS) that one or more supporting career steps need to be identified through a job-task analysis to support the building operations profession.

APPENDIX B: PROFESSIONAL TESTING SCHEME COMMITTEE MEETING SUMMARY – BUILDING ENERGY AUDITOR

Professional Testing

Meeting Summary

Client	U.S. Department of Energy (DoE) National Institute of Building Sciences (NIBS)
Date	August 19 - 20, 2014
Location	Professional Testing Denver Office
Objective	Determine Scheme Committee Requirements for Energy Auditor
Participants	Song Deng John Dunlap David Eldridge H. Jay Enck (absent) Casey Martin Rick Meinking (absent) Khalis Nagidi Shiva Subramanya Scott Gordon Richard Vaillencourt
NIBS Project Manager	Deke Smith, Executive Director, building **SMART** alliance and Program Director, Commercial Workforce Credentialing Council
Professional Testing Facilitator	Dr. Christine Niero, Facilitator Vice President, Professional Testing, Inc.
Observer	Leen Zaballero
Purpose	To determine scheme requirements for the Energy Auditor in conformity with ISO/IEC 17024:2012 Accreditation Requirements

Summary of Discussion

Dr. Niero of Professional Testing, Inc. began the meeting with welcoming address and introductions. Dr. Niero explained the purpose of the meeting and provided an overview of the certification program activities that had occurred thus far in the development of a certification examination for the Energy Auditor.

Overview of ISO/IEC 17024 and Certification

Dr. Niero then gave a brief overview of scheme requirements of ISO/IEC 17024:2012 *Conformity assessment–general requirements for bodies operating certification of persons* as administered by the American National Standards Institute (ANSI), noting that the certification programs sponsored by DoE and NIBS were to conform to these accreditation standards.

Report of the Energy Auditor Validation Survey

Dr. Niero provided an overview of the Job Task Analysis process for the Energy Auditor conducted February 3 – 5, 2014 and reported the demographic findings of the validation survey, including: states in which energy auditors work; sector (public/private); highest level of education; years of experience in energy; and years of experience as an energy auditor. The demographic data was presented to provide a profile of job incumbents in energy auditng. Dr. Niero then provided an overview of the Examination Blueprint and the DACUM chart of duties and tasks; knowledge, skills, abilities and attributes; tools, equipment and resources to orient the task force participants about the job energy auditors perform, and the foundation for the certification examination.

Work of the Scheme Committee

Task force participants were provided a copy of the JTA Report and the DACUM chart for review and reference. As a group of the whole, task force participants began to discuss the requirements for certification, including eligibility to qualify for the exam, at a high level, answering the question "What does the energy auditor" look like in terms of experience, education, and other work-related experiences. Once the group identified broad parameters for certification and eligibility, they broke into three work groups to accomplish the following:

1. Draft requirements for certification based on the competencies, identifying tasks that can be assessed on a written exam, and those that can't be tested but candidates need to pre sent with in order to earn the certification
2. Draft eligibility requirements for their respective work group category
3. Determine equivalencies where possible for degree and work-related experiences, including military experience
4. Provide definitions and parameters for each requirement so the applicant can easily understand the requirement
5. Determine how information can be documented on an application
6. List supporting documentation provided with submission of the application.

Participants were instructed to:

1. Ask "why" have the requirement(s)
2. Ask "what" assurances the requirement(s) provides for establishing eligibility, and to consider aspects of "fairness" to applicants
3. Ask "what" assurances the requirement(s) provides to matters such as safety, ethics, etc.
4. Ask "what" documentation would be required to demonstrate an applicant meets the requirement(s)
5. Ask what level of "trust" and degree of "confidence" the requirement provides that supports the ability of the energy auditor to perform their job

6. Ask "what" the eligibility requirement or certification requirement assures that the exam cannot test.

Once participants completed the group activities, the groups reported their recommendations for eligibility and the rationale to support specific requirements. Once all presentations were made, the full group discussed each requirement and arrived at the final set of eligibility requirements.

The following requirements for eligibility to take the certification exam were agreed upon by the group:

Completion of five commercial (non-residential) audits, with a minimum of two building use types, completed within three years of applying for the exam. Verification of completion of audit will need to be included on the application for certification.

Two (2) hours of CE in safety training. Safety courses taken to maintain licensing requirements, certification requirements in a related field, employer sponsored/required, or to meet state requirements will be accepted.

AND

1. Licensed engineer or architect plus a minimum of two years' experience in energy auditing.*

OR

2. Degree in engineering or five or six year architecture degree and a minimum of three years' experience in energy auditing.

OR

3. Four year science, technology, math degree or four year architecture degree with four years' experience in energy auditing.

OR

4. Two year technical degree or vocational training certificate in mechanical/electrical engineering technology and a minimum of four years' experience in energy auditing. Military would qualify under this option.

OR

5. Four year non-STEM degree and a minimum of five years' experience in energy auditing.

OR

6. Completion of high school diploma or GED and a minimum of seven years' experience in energy auditing.

*Energy auditing experience is defined as successfully completing or participating in activities, at a minimum:

a. Visit job sites to collect data for energy conservation analyses.
b. Evaluate construction design information like drawings, design calculations, system layouts, and sketches.
c. Evaluate energy systems including heating, ventilation, and air conditioning (HVAC), lighting and other building/industrial mechanical systems.
d. Monitor and analyze energy consumption patterns and provide benchmarking analysis.
e. Identify potential energy saving measures along with constructability requirements.
f. Perform energy modeling or other energy calculation.
g. Verify energy bills and meter readings.
h. Prepare a report of the findings.

Recertification Requirements for Energy Auditor

Dr. Niero provided an overview of the purposes of recertification, and a summary of the requirements for Energy Auditors. The three year recertification cycle was determined, with the following activities approved for recertification. Fifty points must be earned within the recertification cycle, with 1 point = 1 hour of activity. Alignment with the competency requirements was determined.

The following requirements were determined, which must align with the competency requirements of the certification (exam blueprint).

Mandatory Audits: Lead, supervise or participate in five commercial (non-residential) audits during the certification cycle. No points awarded.

2 hours of CE in safety training (see CE below). Safety courses taken to maintain licensing requirements, certification requirements in a related field, employer sponsored/required, or to meet state requirements will be accepted. 1 hour of training in safety = 1 CE.

PLUS

Recertification Options: 50 points must be earned from the following options, or combination of options.

Audits: Up to five additional audits at five points per audit (maximum 25 points). Must lead, supervise, or participate in these audits.

Continuing Education (CE): CE is a process used by certified persons to maintain and advance their competency. CE includes education/training received and education/training given and may be obtained from several sources, including:

In-service training—up to 3 points

Webinars—1 point per hour of attendance; 2 points per hour as presenter

Conference Presentation—1 point per hour of attendance; 2 points per hour as presenter

Workshops—1 point per hour of attendance; 2 points per hour as presenter

College Credit (traditional or online)—10 points per college credit

Self-directed Learning—up to 3 points

Regulatory work: Participation in development or maintenance of a state or ANSI standard related to energy auditing. Participation includes attending meetings, official review, appointment as a committee member. Includes regulatory compliance analysis (i.e., energy modeling for 90.1 Title 24 or 189.1) and support lent to legislation/regulation for support of energy auditing (not lobbying)—up to 20 points

Retesting: Meet the current qualify for and pass the certification exam: 50 points

Contributing to the Energy Auditor Certification: Includes participation in Job Task Analysis (JTA) study, item writing, item review, and passing score study)—up to 25 points

Participation in JTA—8 CEs per day

Item Writing—8 CEs per day; 1 CE for every hour of webinar or remote writing

Item Review—8 CEs per day; 1 CE for every hour of webinar or remote review

Passing Score Study—8 CEs per day; 1 CE for every hour of webinar or remote participation

Publications: Must be related to the industry, which is defined as MEP systems, lighting, renewable energy, and other building services and systems as they pertain to efficient use of energy and water: Up to 20 points—points are awarded per publication as follows:

Published conference or technical paper; must be peer reviewed and published—10 points

Providing a review of conference or technical paper; electronic or written confirmation of completed review—1 point

Author a book, manual or guideline that is published; applies to describing energy efficiency or calculation methods. Credit is awarded at the time of publication—20 points

Journal, bulletin, or magazine article—10 points for peer reviewed; 5 points for non-peer reviewed

Whitepaper or position paper; may be digitally published and distributed. Provide documentation of delivery method—5 points

User's Manual for industry standards; contributing to User's Manual as author or peer reviewer—5 points

Author or co-author for chapter of technical handbook; credit is awarded when published—2 points

Review of a technical handbook chapter; credit is awarded when review is completed—1 point.

Code of Ethics

Dr. Niero provided an overview of the purposes of the Code of Ethics and the disciplinary program for certified individuals. The following Code of Ethics was reviewed and approved (see attached) and will be adopted pending revisions provided by other scheme committees. It was recommended that one Code of Ethics be adopted and used by all four scheme committees. The following types of sanctions were approved. Sanctions shall be based on the severity of the violation, and shall include, but not be limited to:

Cease and Desist
Written reprimand
Written reprimand with remediation
Censure
Suspension
Revocation
Permanent revocation

In addition to imposing sanctions, certification bodies shall have the authority to report sanctions to legal and regulatory authorities, and other credentialing organizations as appropriate.

Alignment of scheme requirements with assessment methodology

Dr. Niero provided an overview of the reviewing the scheme requirements with the assessment methodology to identify any competency requirements not being assessed, and for determining alternative methods of assessment, if appropriate and necessary. The Scheme Committee determined that all competency requirements could be assessed in the multiple-choice exam.

Follow-up:

1. Review any changes to the Code of Ethics other scheme committees may make, and approve one Code of Ethics for all four certifications.
2. Vote to adopt the scheme.
3. Present scheme to the CWCC Board of Advisors and the Board of Direction.

APPENDIX C: PROFESSIONAL TESTING SCHEME COMMITTEE MEETING SUMMARY – BUILDING COMMISSIONING PROFESSIONAL

Professional Testing

Meeting Summary

Client	U.S. Department of Energy (DoE) National Institute of Building Sciences (NIBS)
Date	August 25 - 26, 2014
Location	Professional Testing Denver Office
Objective	Determine Scheme Committee Requirements for Building Commissioning Professional
Participants	Rick Bennett Jim Bochat Michael Chelednik Rick Farrington Maureen Guttman Joe Helm Mike Locke Hendrick Munoz John Villani Steve Wiggins
NIBS Project Manager	Deke Smith, Executive Director, building **SMART** alliance and Program Director, Commercial Workforce Credentialing Council
Professional Testing Facilitator	Dr. Christine Niero, Facilitator Vice President, Professional Testing, Inc.
Observer	Maureen Roskoski, Senior Professional, Facility Engineering Associates on August 25th.
Purpose	To determine scheme requirements for the Building Commissioning Professional in conformity with ISO/IEC 17024:2012 Accreditation Requirements

Summary of Discussion

Dr. Niero of Professional Testing, Inc. began the meeting with welcoming address and introductions. Dr. Niero explained the purpose of the meeting and provided an overview of the certification program activities that had occurred thus far in the development of a certification examination for the Building Commissioning Professional.

Overview of ISO/IEC 17024 and Certification

Dr. Niero then gave a brief overview of scheme requirements of ISO/IEC 17024 *Conformity assessment– general requirements for bodies operating certification of persons* as administered by the American National Standards Institute (ANSI), noting that the certification programs sponsored by DoE and NIBS were to conform to these accreditation standards.

Report of the Building commissioning professional Validation Survey

Dr. Niero provided an overview of the Job Task Analysis process for the Building Commissioning Professional conducted February 19 – 21, 2014 and reported the demographic findings of the validation survey, including: highest level of education; years of energy experience; years of experience specifically as a building commissioning professional, sector in which respondents work, and state/geographic area in which respondents work. The demographic data was presented to provide a profile of job incumbents in building commissioning. Dr. Niero then provided an overview of the Examination Blueprint and the DACUM chart of duties and tasks; knowledge, skills, abilities and attributes; tools, equipment and resources to orient the task force participants about the job building commissioning professionals perform, and the foundation for the certification examination.

Work of the Scheme Committee

Task force participants were provided a copy of the JTA Report and the DACUM chart for review and reference. As a group of the whole, task force participants began to discuss the requirements for certification, including eligibility to qualify for the exam, at a high level, answering the question "What does the building commissioning professional" look like in terms of experience, education, and other work-related experiences. Once the group identified broad parameters for certification and eligibility, they broke into three work groups to accomplish the following:

1. Draft requirements for certification based on the competencies, identifying tasks that can be assessed on a written exam, and those that can't be tested but candidates need to present with to earn the certification
2. Draft eligibility requirements for their respective work group category
3. Determine equivalencies where possible for degree and work-related experiences, including military experience
4. Provide definitions and parameters for each requirement so the applicant can easily understand the requirement
5. Determine how information can be documented on an application
6. List supporting documentation provided with submission of the application.

Participants were instructed to:

1. Ask "why" have the requirement(s)
2. Ask "what" assurances the requirement(s) provides for establishing eligibility, and to consider aspects of "fairness" to applicants

3. Ask "what" assurances the requirement(s) provides to matters such as safety, ethics, etc.
4. Ask "what" documentation would be required to demonstrate an applicant meets the requirement(s)
5. Ask what level of "trust" and degree of "confidence" the requirement provides that supports the ability of the building commissioning professional to perform their job
6. Ask "what" the eligibility requirement or certification requirement assures that the exam cannot test.

Once participants completed the group activities, the groups reported their recommendations for eligibility and the rationale to support specific requirements. Once all presentations were made, the full group discussed each requirement and arrived at the final set of eligibility requirements.

The following requirements for certification were agreed upon by the group:

Eligibility Requirements for the Building Commissioning Professional Examination

The Scheme Committee reviewed the DACUM charts task by task, and identified the tasks and associated KSAs that could be tested, and those that could be verified through experience or other requirements. The following eligibility requirements to take the Building Commissioning Certification examination were agreed upon.

Participate in a minimum of three commissioning projects. The projects may not include one and -two family residential buildings. Over the projects, the applicant must have participated in the following activities:

- development of an OPR/CFR
- develop commissioning plan
- review of a design
- perform field verification
- oversee performance testing
- correction of deficiencies
- training
- prepare commissioning report.

And One of the following options

1. Licensed Architect or Professional Engineer with three years' commissioning experience.

2. Bachelor's degree in building sciences* or equivalent military training/experience, with five years' experience in building commissioning.

3. Associate/Technical/Vocational 2 year degree, non-building sciences bachelor's degree, or equivalent military training/experience, with eight years' building industry experience**, with five of those years in building commissioning.

4. High school diploma or GED with 10 years' experience in building industry experience**, with five of those years in building commissioning.

*Building science education is defined as mechanical engineering, electrical engineering, construction science, construction management, architecture and other majors/fields of study designed to train people for careers in the building industry.

**Building industry experience is defined as design, construction, testing and commissioning, code enforcement and operations.

Recertification Requirements for Building Commissioning Professional

Dr. Niero provided an overview of the purposes of recertification, and a summary of the requirements for building commissioning professionals. The three year recertification cycle was determined, with the following definitions supporting the requirements. 50 points are required, with 1 point = 1 hour of activity. The following requirements for recertification were determined. Alignment with competency requirements (examination blueprint) was determined.

Mandatory Requirement: Must participate in leading, planning, coordinating or managing a commissioning team to implement commissioning processes for a minimum of one project. No points awarded.

Continuing Education: Continuing Education (CE): CE is a process used by certified persons to maintain and advance their competency. Only CEs that include proof of attendance from a third party qualify. A minimum of 25 CEs must be from education/training received. CE includes education/training received and may be obtained from several sources, including:

Webinars—1 point per hour of attendance

Conference Session—1 point per hour of attendance

Workshops—1 point per hour of attendance

College Credit (traditional or online)—10 points per college credit

Training online or in person—1 point per hour of attendance

PLUS a combination of the following options to total 50 points:

1. Continuing Education: Continuing Education. Only CEs that include proof of attendance from a third party qualify. Up to 25 CEs may be obtained from this option. CE includes education/training received and education/training given, and may be obtained from several sources, including:

   Webinars—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentation

Conference Presentation—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations

Workshops—1 point per hour of attendance; 2 points per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations

College Credit (traditional or online)—10 points per college credit

Training online or in person—1 point per hour of attendance; 2 points per hour as a presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations

2. Certification Test Development: Includes contributing to the development of the Building Commissioning Professional certification examination by participating in the following test development activities: job-task analysis study; item writing workshops; item review and/or passing score studies; 2 points awarded for 1 hour of participation—up to 25 points.

3. Regulatory Work: Participation in development or maintenance of regulatory standards. Participation includes providing testimony, official review, and/or appointment as a committee member. Includes regulatory compliance analysis and support lent to legislation/regulation for support of building commissioning professionals (not lobbying); 1 point awarded for 1 hour of participation—up to 10 points.

4. Retest: Meet the current qualifications for and pass the certification exam: 25 points

5. Publications: Must be related to the industry, which is defined as design, construction, testing and commissioning, code enforcement and operations; published article in a peer-reviewed industry journal—5 points per article, up to 10 points.

Code of Ethics

Dr. Niero provided an overview of the purposes of the Code of Ethics and the disciplinary program for certified individuals. The following Code of Ethics was adopted. The following types of sanctions were approved and shall include, but not be limited to:

Cease and Desist
Written reprimand
Written reprimand with remediation
Censure
Suspension
Revocation
Permanent revocation

In addition to imposing sanctions, certification bodies shall have the authority to report sanctions to legal and regulatory authorities, and other credentialing organizations as appropriate.

Alignment of scheme requirements with assessment methodology

Dr. Niero provided an overview of the reviewing the scheme requirements with the assessment methodology to identify any competency requirements not being assessed, and for determining alternative methods of assessment, if appropriate and necessary. It was determined that all scheme requirements are assessed at eligibility or are on the exam blueprint.

Next steps

1. Agree that educational institutions are accredited by an accreditation agency recognized by the U.S. Department of Education or Council on Higher Education Accreditation (CHEA), and transcripts from applicants of schools outside of the U.S. be reviewed for equivalency by a third-party agency.
2. Create a sample check-list of experience requirements for commissioning projects to assist CBs in developing the application for certification. Check-lists to include verification that experience was obtained.
3. Determine if a gap analysis between existing certifications in building commissioning and the requirements of the NIBS scheme in building commissioning can be conducted to determine common competency requirements and gaps in exam content between the entities, with the possibility of creating a bridge for currently certified individuals to enter the NIBS scheme.
4. Vote to adopt the scheme.
5. Present scheme to the CWCC Board of Advisors and the Board of Direction.

APPENDIX D: BUILDING OPERATIONS PROFESSIONAL – JTA/DACUM EXTRACT

JOB/TASK ANALYSIS (JTA)
DACUM CHART
FOR

BUILDING OPERATIONS PROFESSIONALS

Conducted for the National Renewable Energy Laboratory (NREL) with Guidance from the Commercial Workforce Credentialing Council National Institute of Building Sciences

Prepared by:

Professional Testing Inc.
7680 Universal Blvd.
Suite 300
Orlando, Florida 32819

Dr. Cynthia Woodley, Facilitator
Tracey Paschal, Recorder
February 10-12, 2014

Building Operations Professional
Job Description

The Building Operations Professional manages the maintenance and operation of building systems and installed equipment, and performs general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity and safety of the building occupants.

A proposed content outline resulting from this Job/Task Analysis follows.

Building Operations Professional	
A	Managing Human Resources
B	Conduct Planning Activities
C	Operating Buildings
D	Optimizing the Facility
E	Conducting Budgeting Activities

Professional Testing would like to thank the following individuals who contributed to this project: Mohamed Amin, Terry Bickham, Mike McBee, Robert Blakey, James Coates, Richard Dames, Howard Day, Charles Frost, Hadley Hartshorn, Christine Maurer, Carlos Santamaria, Daniel Sexton, Daryl Walker, Rod Weiss, and Anthony Zotto.

Professional Testing would also like to thank
Deke Smith National Institute of Building Sciences (NIBS).

Final Exam Blueprint for Building Operations Professionals

Duties and Tasks				Percent	Items
A			**Managing Human Resources**	8%	10
	1		Develop workload analyses	1%	1
	2		Analyze staffing productivity	2%	3
	3		Supervise building staff	4%	5
	4		Secure outside service providers	1%	1
B			**Conduct Planning Activities**	15%	18
	1		Update procedures (SOPs, BOPs, operating plans, emergency plans, etc.)	3%	4
	2		Develop equipment operations plans	2%	2
	3		Develop planned maintenance schedules	3%	4
	4		Contribute to construction standards and guidelines	2%	2
	5		Contribute to capital renewal plans	3%	4
	6		Conduct Data Management Activities	2%	2
C			**Operating Buildings**	50%	59
	1		Perform workplace hazard assessments	2%	3
	2		Participate in emergency drills	2%	3
	3		Manage the PPE program	2%	3
	4		Manage third party inspections	2%	2
	5		Respond to building emergencies	2%	2
	6		Managing building securities	2%	2
	7		Coordinate/conduct occupant training	2%	2
	8		Conduct risk management activities	2%	2
	9		Manage responses to inclement weather conditions/issues	2%	3
	10		Respond to tenant requests/issues	2%	2
	11		Conduct equipment checks	2%	2
	12		Conduct daily rounds	2%	2
	13		Coordinate facility operations (normal)	2%	2
	14		Coordinate facility operations (other than normal)	2%	2
	15		Manage the work order process	2%	3
	16		Investigate indoor environmental quality	2%	3
	17		Conduct tenant relations activities	2%	2
	18		Manage consumables	2%	2
	19		Manage outside facility contractors/service providers	2%	3
	20		Manage environmental requirements (permits, etc.)	2%	3
	21		Implement an energy management program	3%	4
	22		Maintain the facility and systems	3%	4
	23		Conduct facility repair activities	2%	3
D			**Optimizing the Facility**	20%	24
	1		Conduct measurement and verification activities	3%	4
	2		Analyze system performance	4%	5
	3		Identify cost saving measures	3%	3

Final Exam Blueprint for Building Operations Professionals

			Duties and Tasks	Percent	Items
	4		Respond to changing energy costs	3%	3
	5		Optimize system performance	5%	6
	6		Identify sustainability opportunities	2%	3
E			**Conducting Budgeting Activities**	7%	8
	1		Contribute to long term facility budget plan (5 years)	2%	2
	2		Contribute to facility operations budget	3%	4
	3		Contribute to capital improvement budget(s)	2%	2
			Total	100%	120

Specialized Knowledge Appearing in DACUM Chart of Building Operations Professionals

Specialized Knowledge	
Adjusting equipment based on readings	Americans with Disabilities Act
Asset inventories	Renewable energy systems
BAS or monitoring systems	Baselines
Basic data architecture	Basic financial terminology
Basic knowledge of contaminant limits	Basic knowledge of insurance policies for equipment and operations
Basic knowledge of tariffs	Basic statistical analyses
Basic utility bill analysis	Benchmarking
Best practices for emergency drills	Biohazards and hazardous chemicals
Break-even analysis	Budget categories
Building certification programs	Building operations and procedures
Building systems* (*see list on pages 6 & 7) (including interdependencies, interoperability, limitations, operating plans, operations, and performance expectations)	Business case development
Chain of custody	Change management techniques
Common or frequent deficiencies	Communications methods (Skype, Webinar, etc.)
Communications plans	Company labor policies
Comparing alternatives to satisfy demands	Conditions under which a building should be evacuated
Consumable logistics	Consumable requirements
Consumable sourcing guidelines	Contaminant containment protocols
Contingency plans/data recovery	Contract knowledge
Contract requirements	Contracts and service providers
Contributors to carbon or environmental footprint	Control systems
Control theory	Costs of systems or improvements
Criticality of various systems and equipment	Customer requirements for business
Decontamination requirements	Deferred issues (deferred maintenance)
Demand management strategies	Distinguishing equivalency between equipment and/or systems
Emergency equipment operation	Emergency procedures including first aid and CPR
Emerging technologies and tools	Energy basics
Energy conservation opportunities	Energy efficiency measures (EEM) and economics
Energy load profiles	EPA regulations
Equipment operations and specifications	Expected life of major building components
Facility knowledge	Failure modes
Familiarity with learning styles	Feasibility studies
Financial knowledge	Financial penalties for going above peak demand threshold
First cost vs. lifecycle costs	First response mitigation techniques (what type of fire extinguisher to use, etc.)
Fluid dynamics	Foot-candles/lumens and lighting concepts
Funding limitations	Funding sources
General knowledge of the authority having jurisdiction	Hazard remediation/clean up

Specialized Knowledge Appearing in DACUM Chart of Building Operations Professionals

Specialized Knowledge	
Hazardous materials disposal	Hazards in the area (earthquakes, etc.)
Hazards management	Health effects of contaminants (including stay times)
Heat transfer	HIPAA requirements
Historical data associated with facility	Human resources
HVAC systems	Impact of change on tenant/occupant space
Impact of facility operations on scheduling	Impact of operational changes (occupancy changes) on performance expectations
Incident command systems (ICS)	Inclement weather escalation plans
Inclement weather local logistics (shelter, food, transportation)	Indicators of problems with equipment
Industry norms for manpower	Infection control procedures
Inspection agencies	Inspection procedures
Insurance requirements	Integrated work management systems structure
Interim life safety measures (fire watch, alternate evacuation routes, etc.)	Interpreting equipment test readings
Inventory control systems	Job responsibilities
Key logic systems (master keys vs. other keys)	Labor contract agreements
Levels of maintenance	Levels of service for various spaces
Licensing requirements	Life cycle assessments
Lifecycle accounting practices	Limitations of PPE
Load demand schedules	Local water restrictions and requirements
Local weather issues	Location of facility equipment
Lock-out/tag-outs	Long term goals of the organization
Maintenance costs of existing systems	Management requirements
Manual equipment operation	Material availability
Measured variables to verify system performance	Measurement equipment and techniques
Medical evaluation policies and requirements	Mitigator of carbon or environmental footprint
Monitoring systems and equipment	Municipal requirement for disposal and recycle of consumables
National Incident Management Systems (NIMs)	New technologies
Normal equipment operating parameters/limits	Normal routine operation of the facility
Obtaining measurements	Occupancy types and typical evacuation procedures for various occupancies
Operating baselines	Operation equipment loads
Operational impact of inspections	Operations within the facility
Options for extending the life of equipment and systems	Organizational security requirements (access requirements, levels of security, etc.)
Organizational structures	Organization's budgeting process
Safety Codes and Standards (including OSHA)	Other submetering systems
Outsourcing options	Owner's long-term plan for the facility
Payment policies	Peak demand loads
Performance improvement plans	Permitting requirements
Permitting resources	Personnel performance review processes
Plumbing systems	Potential contaminants

Specialized Knowledge Appearing in DACUM Chart of Building Operations Professionals

Specialized Knowledge	
Potential environmental, health and safety (EHS) hazards and risks	PPE and proper usage and maintenance of PPE
Procurement policies and procedures	Procurement regulations
Proper procedures for isolating and removing hazards	Psychrometrics
Rate schedules for utilities	Reclamation techniques
Recommended maintenance schedules	Refrigerant recovery techniques
Regulated consumables	Regulatory record requirements
Relationship between deficiencies and energy efficiency	Remediation activities for contaminants
Remediation procedures	Remote monitoring systems and equipment
Remote system fluency (DDC, etc.)	Reporting capabilities of work order systems
Reporting requirements for emergencies	Resource planning personnel management
Resources required for typical tenant/occupant requests and issues	RFP Process
Root cause analysis techniques	Safety codes and standards (including OSHA)
Safety concerns associated with equipment operations	Safety practices
Scope of work	Security equipment (lighting, cameras, etc.)
Security policies and procedures	Sequence of equipment operations
Sequence of operations	Service level agreements
Services to be outsourced	Shelf life of consumables
SOPs related to equipment	Specialized emergency equipment
State and local energy mandates	Storage requirements for consumables
Sustainability options	System documentation requirements
Technical equipment knowledge	Technical knowledge
Tenant/occupant chain of command	Tenant/occupant contracts
Tenant/occupant equipment and requirements	Tenant/occupant hours of operation
Tenant/occupant needs and schedules	Tenant/occupant operations and space uses
Tenant/occupant requirements	Tenant/occupant tolerances in changes to systems
Testing and balancing procedures	Thermodynamics
Trade and Union requirements	Trade knowledge for specific equipment and systems
Trade terminology and definitions	Trend analysis
Typical characteristics of facilities and equipment	Typical non-energy costs
Typical training topics	Understanding of all staff functions carried out in the facility
Understanding of interlocked equipment	Understanding of load shedding and its importance
Understanding of photometric charts	Understanding of staffing models (vacation, sick leave, etc.)
Uninterruptable and critical systems	Utility bill analysis
Utility rate structures and schedules	Utility time of use
Vendors	Ventilation requirements for consumables
Weather impact on the facility	Weather related factors affecting equipment

Specialized Knowledge Appearing in DACUM Chart of Building Operations Professionals

Specialized Knowledge	
	(temperatures, dew points, etc.)
When substitutions of equipment or systems are not allowed	When to conduct IEQ tests
Whole building integration	Work control procedures
Work order processes	

* Building Systems
Air compressor and distribution system
Air distribution system
Building automation system
Building control system
Building envelope
Chilled water system
Combined heat and power system
Communication systems
Condenser water system
Conveyance systems
Cooling generation equipment
District energy systems
Domestic hot water system
Electrical power system
Elevator/escalator systems
Emergency alert systems
Energy metering and monitoring system
Energy recovery system
Fresh air systems
Fuel storage and distribution systems (USTs, ASTs, etc.)
Heat generation equipment
HVAC control system
HVACR system
Irrigation equipment
Life safety systems
Lighting control system
Lighting system
Onsite energy generation system (CHP, PV, Wind, Thermal, generators, etc.)
Potable cold water system
Primary sewer/gray water systems
Process systems and controls
Pumps and pumping system
Renewable energy system
Specialty exhaust systems

Specialized Knowledge Appearing in DACUM Chart of Building Operations Professionals

* Building Systems
Standpipe/sprinkler systems
Steam and hot water system
Steam distribution system
Thermal energy storage system
Uninterruptible power systems (UPSs)/Building Energy Storage Systems (BSS)
Variable drive system
Water distribution and control system

General Knowledge Ordered by Importance for Building Operations Professionals

General Knowledge
Calculations
Perform simple math operations of division
Perform simple math operations of addition
Perform simple math operations of subtraction
Perform simple math operations of multiplication
Use a calculator
Compare numbers
Perform mathematical operations with decimals
Collect information to solve a problem
Perform math operations using single and multiple digit numbers
Make rough estimates
Transfer number sequences from a source into a column
Figure averages
Perform mathematical operations with fractions
Solve percent problems
Solve ratio problems
Perform math operations using signed (positive and negative) numbers
Change numbers from fractions into decimals and back
Change numbers from percentages into decimals and back
Measure angles
Solve problems with graphs
Multiply and factor algebraic expressions
Solve formula calculations with one unknown
Basic Measurement
Read measurements taken with common measuring tools
Measure temperature to within 1 degree Fahrenheit
Measure linear distances (length, width, etc.)
Calculate the perimeter and areas of common figures
Estimate and approximate measurements
Record measurements, using appropriate unit notations (feet, yards, etc.)
Measure area (square inches, square centimeters, etc.)
Measure volume (cubic inches, liters, etc.)
Use tools to measure quantities and solve problems involving measurements
Find the dimensions of an object from a scale drawing
Read, interpret, and use size-scale relationships
Read and use the scale of a drawing
Measure length to 1/4 of an inch
Measure length to 1/8 of an inch
Measure length to 1/16 of an inch
Measure weights using devices calibrated in ounces

General Knowledge Ordered by Importance for Building Operations Professionals

General Knowledge
Basic Measurement (continued)
Measure weights using devices calibrated in pounds
Find distances and directions on land maps
Make simple scale drawings
Convert measurements from one unit to another (English to Metric, etc.)
Measure length to 1/32 of an inch
Read and apply coefficient measurements indicated in a table or chart
Measure accurately to 0.01 inches
Measure board feet
Communications
Ask questions
Communicate using the vocabulary/terminology of a related trade
Follow verbal job instructions
Communicate with co-workers and/or business people verbally (face-to-face)
Listen
Read and follow directions found in equipment manuals and code books
Read and interpret directions found on labels, packages, or instruction sheets
Read drawings and specifications sheets
Communicate with co-workers and/or business people verbally (telephone, radio)
Evaluate options/alternatives
Read codes (building codes, electrical codes, standards, etc.)
Evaluate solutions
Read information from tables and graphs (bar, circle, etc.)
Explain procedures
Read and follow a map, chart, plan, etc.
Write words and numbers legibly
Communicate with co-workers and/or business people in writing (letters, memos)
Find information in catalogs
Find information in references (Machinery handbook, tap/drill charts, etc.)
Read flowcharts
Research information
Read statistical data
Participate in brainstorming
Present to others
Summarize information
Write reports
Apply assertiveness
Compare names

APPENDIX E: BUILDING ENERGY AUDITOR – JTA/DACUM EXTRACT

JOB/TASK ANALYSIS (JTA)
DACUM CHART
FOR

BUILDING ENERGY AUDITORS

Conducted for the National Renewable Energy Laboratory (NREL) with Guidance from the Commercial Workforce Credentialing Council National Institute of Building Sciences

Prepared by:

Professional Testing

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Dr. Cynthia Woodley, Facilitator
Christine DePascale, Co-Facilitator
February 3-5, 2014

Building Energy Auditor
Job Description

The Commercial Building Energy Auditor is an energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy usage; and recommends strategies to optimize building resource utilization.

A proposed content outline resulting from this Job/Task Analysis follows.

Building Energy Auditor	
A	Communicating with Stakeholders
B	Developing the Action Plan
C	Conducting Pre-Site Visit Data Collection Activities
D	Collecting Data On-Site
E	Analyzing Building Performance Data
F	Identifying Opportunities for Improving Building Performance
G	Producing the Deliverable

Professional Testing would like to thank the following individuals who contributed to this project: Heather Buckberry, Christopher Crall, John Dunlap, David Eldridge, H.Jay Enck, Cristian Harbaugh, Jennifer King, Terry Niehus, Sonya Pouncy, David Redding, Shiva Subramanya, Terry Townsend, and Jon Weiskopk.

Professional Testing would also like to thank
Deke Smith National Institute of Building Sciences (NIBS).

Final Exam Blueprint for Building Energy Auditors

Duties and Tasks				Percent	Items
A			**Communicating with Stakeholders**	5%	5
	1		Identify the owner's project team	1%	1
	2		Review the scope and process with the client	4%	4
B			**Developing the Action Plan**	7%	7
	1		Conduct pre-audit activities	2%	2
	2		Generate preliminary list of systems and assemblies to be audited	2%	2
	3		Determine audit tools and forms	1%	1
	4		Determine project schedule	1%	1
	5		Identify safety and access requirements of the facility	1%	1
C			**Conducting Pre-site Visit Data Collection Activities**	4%	4
	1		Obtain utility information	1%	1
	2		Obtain facility data from point of contact	1%	1
	3		Gather historical weather data	2%	2
D			**Collecting Data On-site**	21%	21
	1		Obtain information from facility staff	2%	2
	2		Obtain information from facility occupants	2%	2
	3		Assess the building envelope	7%	7
	4		Assess building systems and components	10%	10
E			**Analyzing Building Performance Data**	25%	25
	1		Establish energy and cost baseline	6%	6
	2		Establish benchmarks	6%	6
	3		Disaggregate the energy end use breakdown	13%	13
F			**Identifying Opportunities for Improving Building Performance**	30%	30
	1		Identify deviations from best practices	6%	6
	2		Determine energy impact of each measure	10%	10
	3		Estimate implementation cost	4%	4
	4		Conduct an economic analysis	10%	10
G			**Producing the Deliverable**	8%	8
	1		Write a summary audit report	8%	8
			Total	100%	100

Specialized Knowledge Appearing in DACUM Chart of Building Energy Auditors

Specialized Knowledge	
Air compressors	Audit processes and tasks
Benchmarking	Building automation control systems and programming
Building physics	Building pressurization
Building sciences	Building systems * engineering concepts and principles (* See separate list)
Components of building and process systems and assemblies	Data collection protocols
Electrical power systems	Energy efficiency measures (EEM) and economics
Energy calculations (e.g. energy modeling)	Engineering economics
Financial analysis methodologies and thresholds (e.g. life cycle costs analysis, ROI)	General building construction materials
Greenhouse gas calculations	Heat transfer
Heating and cooling degree days and balance point temperature	Historic building practices
IEQ	Impact of age of building on building systems
Industry accepted standards, codes and guidelines	Industry equipment
Industry terminology	M&V methodologies
Maintenance procedures and roles	Measurement equipment (current transformers, data loggers, etc.) and techniques
Minimum required time period of utility data	Onsite energy generation (CHP, PV, wind, thermal, etc.)
Operations within the facility	Potential environmental, health, and safety (EHS) hazards and risks
Process systems and controls	Rebates and incentives
Safety practices	Sampling protocols and procedures
Solar mapping	Systems interactions and integration
Types of audits (level 1, 2, or 3, etc.)	Typical energy analysis methodologies
Typical energy usage by building type	Typical percentage of end usage by occupancy type
Understand available data types for weather (bin data, hourly data, TMY, etc.)	Understanding of engineering practices and principles
Understanding of industry best practices for various building systems	Understanding of utility bill information
Understanding of what an energy audit is	Utility rate structures and schedules
When a building needs to be "tuned up" versus new installations	Window types

Specialized Knowledge Appearing in DACUM Chart of Building Energy Auditors

*Building Systems
Air compressors
Building automation control systems and programming
Building HVACR systems
Building interior and exterior lighting fixtures and controls
District energy
Electrical power systems
Low temperature refrigeration systems
Onsite energy generation (CHP, PV, wind, thermal, etc.)
Process systems and controls
Service hot water and control systems
Water distribution and control systems

General Knowledge Ordered by Importance for Building Energy Auditors

General Knowledge
Calculations
Perform simple math operations of addition
Perform simple math operations of subtraction
Perform simple math operations of multiplication
Perform simple math operations of division
Use a calculator
Compare numbers
Figure averages
Perform mathematical operations with fractions
Perform mathematical operations with decimals
Perform math operations using single and multiple digit numbers
Change numbers from percentages into decimals and back
Transfer number sequences from a source into a column
Solve ratio problems
Solve percent problems
Perform math operations using signed (positive and negative) numbers
Multiply and factor algebraic expressions
Collect information to solve a problem
Solve formula calculations with one unknown
Change numbers from fractions into decimals and back
Make rough estimates
Solve problems with graphs
Solve formula calculations with more than one unknown
Perform math operations using exponential numbers
Measure angles
Solve right triangle problems using Pythagorean theorem
Perform angular calculations
Solve right triangle trigonometry problems
Solve oblique triangle problems
Solve triangle-circle problems
Solve angle-circle problems
Solve oblique triangle trigonometry problems
Solve compound angle problems
Basic Measurement
Convert measurements from one unit to another (English to Metric, etc.)
Record measurements, using appropriate unit notations (feet, yards, etc.)
Measure area (square inches, square centimeters, etc.)
Read and use the scale of a drawing
Read measurements taken with common measuring tools
Use tools to measure quantities and solve problems involving measurements

General Knowledge Ordered by Importance for Building Energy Auditors

General Knowledge
Basic Measurement (continued)
Estimate and approximate measurements
Read, interpret, and use size-scale relationships
Read and apply coefficient measurements indicated in a table or chart
Measure temperature to within 1 degree Fahrenheit
Find the dimensions of an object from a scale drawing
Measure linear distances (length, width, etc.)
Measure volume (cubic inches, liters, etc.)
Calculate the perimeter and areas of common figures
Make simple scale drawings
Communications
Ask questions
Evaluate options/alternatives
Evaluate solutions
Listen
Write reports
Communicate using the vocabulary/terminology of a related trade
Communicate with co-workers and/or business people verbally (face-to-face)
Explain procedures
Follow verbal job instructions
Read information from tables and graphs (bar, circle, etc.)
Find information in references (Machinery handbook, tap/drill charts, etc.)
Read drawings and specifications sheets
Research information
Summarize information
Communicate with co-workers and/or business people verbally (telephone, radio)
Communicate with co-workers and/or business people in writing (letters, memos)
Read codes (building codes, electrical codes, standards, etc.)
Read statistical data
Write words and numbers legibly
Find information in catalogs
Read and follow a map, chart, plan, etc.
Read and follow directions found in equipment manuals and code books
Present to others
Participate in brainstorming
Read flowcharts
Read and interpret directions found on labels, packages, or instruction sheets
Compare names

Skills and Abilities Appearing in DACUM Chart of Building Energy Auditors

Skills and Abilities	
Ability to communicate technical information to others	Ability to comprehend technical documentation
Ability to convert units	Ability to determine tools needed for an audit
Ability to recognize abnormalities	Ability to interpret scheduling tools (Gantt chart, milestone, etc.)
Ability to interpret thermography	Ability to interpret utility bills, rate structures and utility contracts
Ability to use conversion factors	Analytical skills
Basic math skills	Basic engineering skills
Computer skills	Construction cost estimating skills
Data collection skills	Decision making ability
Detail-oriented	Diagnostic abilities
Documentation skills	Interpersonal skills
Interviewing skills	Listening skills
Normalizing data	Observational skills
Organizational skills	Problem solving skills
Programming skills	Project management skills
Quantitative analysis skills	Reading ability
Technical writing skills	Troubleshooting skills
Verbal communication skills	Word processing skills
Written communication skills	

APPENDIX F: BUILDING COMMISSIONING PROFESSIONAL – JTA/DACUM EXTRACT

JOB/TASK ANALYSIS (JTA)
DACUM CHART
FOR

BUILDING COMMISSIONING PROFESSIONALS

Conducted for the National Renewable Energy Laboratory (NREL) with Guidance from the Commercial Workforce Credentialing Council National Institute of Building Sciences

Prepared by:

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Dr. Cynthia Woodley, Facilitator
Christine DePascale, Co-Facilitator
February 19-21, 2014

Building Commissioning (Cx) Professional
Job Description

The Building Commissioning (Cx) Professional is an individual who leads, plans, coordinates and manages a commissioning team to implement commissioning processes in new and existing buildings.

A proposed content outline resulting from this Job/Task Analysis follows.

Building Commissioning (Cx) Professional	
A	Managing Commissioning Projects
B	Preparing Commissioning Documentation
C	Conducting Commissioning Activities
D	Managing Training Activities
E	Completing Warranty Phase Activities
F	Conducting Existing Building Commissioning
G	Conducting On-going Commissioning

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Stephen R. Wiggins.

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Deke Smith National Institute of Building Sciences (NIBS).

Final Exam Blueprint for Building Commissioning Professional

		Duties and Tasks	Final Weight	Final Items
A		Managing Commissioning Projects	18%	22
	1	Identify the scope of the project	1%	1 to 2
	2	Develop a commissioning team	1%	1 to 2
	3	Manage a commissioning budget	1%	1 to 2
	4	Identify commissioning deliverables	1%	1 to 2
	5	Participate in VE activities	1%	1 to 2
	6	Review project documents	1%	1 to 2
	7	Monitor the construction/project schedule	1%	1 to 2
	8	Participate in project meetings	1%	1 to 2
	9	Conduct commissioning meetings	1%	1 to 2
	10	Track deficiencies (issues log)	2%	2
	11	Facilitate risk assessment as it relates to commissioning activities	2%	2
	12	Assess pass/fail criteria for functional test results	3%	4
	13	Identify tasks for completion of commissioning processes	2%	2
B		Preparing Commissioning Documentation	19%	23
	1	Assist in developing the OPR/CFR	1%	1 to 2
	2	Create system/equipment list	1%	1 to 2
	3	Create commissioning process tracking matrices	1%	1 to 2
	4	Develop the commissioning plan	2%	2
	5	Develop commissioning schedules	1%	1 to 2
	6	Develop communications plans	1%	1 to 2
	7	Create commissioning specifications	1%	1 to 2
	8	Write system verification checklists	2%	2
	9	Create FPTs	3%	4
	10	Determine site visit protocols (logistics)	0%	0
	11	Develop issues logs	1%	1 to 2
	12	Document commissioning meetings	1%	1 to 2
	13	Write commissioning reports	2%	2
	14	Create systems manuals	1%	1 to 2
	15	Develop end of warranty review processes	1%	1 to 2
C		Conducting Commissioning Activities	24%	29
	1	Plan commissioning construction activities	7%	7 to 8
	2	Monitor commissioning construction activities	7%	7 to 8
	3	Facilitate the completion of construction checklists	3%	4
	4	Facilitate the acceptance phase	7%	7 to 8
D		Managing Training Activities	4%	5
	1	Develop training plan	2%	2

	2	Facilitate training coordination meeting	1%	1 to 2
	3	Facilitate training activities	1%	1 to 2
	4	Conduct training follow-up activities	0%	0
E		Completing Warranty Phase Activities	5%	6
	1	Facilitate off-season testing	1%	1 to2
	2	Troubleshoot facility issues	1%	1 to 2
	3	Measure energy performance	2%	3
	4	Facilitate end of warranty meeting	1%	1 to 2
F		Conducting Existing Building Commissioning	23%	28
	1	Determine Scope of Project	2%	1 to 2
	2	Conduct a building performance assessment	3%	4
	3	Prepare a CFR	2%	1 to 2
	4	Conduct a systems assessment	3%	4
	5	Conduct a site investigation	3%	4
	6	Recommend corrections and improvements	3%	4
	7	Oversee implementation of corrective measures	3%	4
	8	Conduct performance verifications	4%	5
G		Conducting On-going Commissioning	7%	8
	1	Measure IEQ performance	1%	1 to 2
	2	Evaluate building systems performance	1%	1 to 2
	3	Review building operating plan	1%	1 to 2
	4	Review maintenance activities	1%	1 to 2
	5	Accommodate space/function changes	1%	1 to 2
	6	Implement corrective actions	1%	1 to 2
	7	Publish measurement and performance results to stakeholders	1%	1 to 2
		Total	**100%**	**120**

Specialized Knowledge Appearing in DACUM Chart of Building Commissioning (Cx) Professionals

Specialized Knowledge	
BAS or monitoring systems	Basic construction
BIM	Budgeting
Building maintenance	Building operations
Building sciences	Building systems * (*see list on pages 3 & 4)
Climate zone variations	CMMS
Commissioned systems knowledge	Construction contracting
Construction budgets and costs	Construction estimating
Construction documents and specifications	Construction methods and concepts
Construction management processes	Contract knowledge
Construction scheduling	Control systems
Controls theory and operations	Cx budgeting
Controls graphics	Cx processes and procedures
Cx manpower requirements	Cx schedules
Cx reporting documentation	Cx team member requirements
Cx sequence of events	Design documents
Data normalization (weather, days of the month, etc.)	Divisions used in construction specifications
Developing ROIs	Economic analyses
Documentation protocols	Energy management fundamentals
Energy calculations	Energy performance
Energy modeling	Engineering principles
Energy use analysis	Evidence collection
Environmental sustainability and efficiency goals	Facilities management
Expected equipment performance	Fault diagnostic knowledge
Failure mode analysis	General construction process knowledge
Functional testing procedures, equipment, and results	IEQ
How system components work together	Integration protocols
Incentive programs	Life-span cost and quality
Issue resolution process	Maintainability, access, and operational requirements
M&V methodologies	Maintenance issues
Maintenance contracts	Maintenance procedures and roles
Maintenance management systems	Manufacturers of Cx equipment
Manpower utilization	Metering
Needs assessment processes	Methodology to inspect systems
Occupancy impacts	O&M Procedures
OPR	Operations within the facility
Owner's operational configuration and personnel	Potential environmental, health, and safety (EHS) hazards and risks
	Project documents
Prevailing commissioning pricing structures	Project management
Project knowledge	Project objectives, goals, and purpose
Project management process	Records/document management
Proportional balancing	Required construction and installation tests
Regression modeling	ROI analysis
Risk assessment and management	Sampling protocols and procedures
Safety practices	Scheduling
	Sequence of construction activities
Scope of work	Service contracts
Sequence of operations	Space usage and occupancy schedules

Specialized Knowledge Appearing in DACUM Chart of Building Commissioning (Cx) Professionals

Specialized Knowledge	
Site safety	Spreadsheet development
Special tests (TAB, etc.)	Start up requirements
Submetering	Successful training outcomes
Substantial completion and final completion	System operations
Survey techniques	Systems engineering
Systems understanding	Systems interactions and integration
Test development	TAB
Testing equipment and procedures	Testing durations
Testing sequencing	Testing procedures
Testing, training, design and construction requirements	Testing standards
Training facilitation	Training evaluation
Training plans	Training methodologies
Trend data	Trend analysis
Troubleshooting techniques	Troubleshooting methodologies
Unique requirements for facility usage	Typical site visit protocols
Utility rate structures and schedules	Utility bill structures
Various control technologies (new and legacy)	Utility rebate incentives
Warranties	Warranty provisions

* Building Systems
Air distribution system
Access controls systems
Audio-visual systems
Automated windows and blinds systems
Building automation system
Building control system
Building envelope
Chilled water system
Combined heat and power system
Communication systems
Condenser water system
Conveying systems
Domestic hot water system
Electrical power quality monitoring system
Electrical power system and Emergency power system
Emergency communication systems
Energy metering and monitoring system
Energy recovery system
Fire alarm system
Fire protection (Sprinkler) system
Fuel oil system
Gray and black water systems
HVAC control system

Specialized Knowledge Appearing in DACUM Chart of Building Commissioning (Cx) Professionals

* Building Systems
HVAC system or HVACR system
Irrigation systems
IT systems
Laboratory gas system
life safety system
Lighting control system
Lighting system
Low temperature refrigeration system
Medical gas systems
Nurse call systems
Plumbing systems
Pneumatic tube systems
Potable cold water system
Public address systems
Pumps and pumping systems
Renewable energy system (CHP, PV, Wind, Thermal, etc.)
Security systems
Smoke evacuation systems
Space scheduling systems
Steam and hot water system (heating)
Steam distribution system
Variable speed (Frequency) drive system
Vertical transportation systems
Water distribution and control system

General Knowledge Ordered by Importance for Building Commissioning (Cx) Professionals

General Knowledge
Calculations
Collect information to solve a problem
Perform simple math operations of addition
Perform simple math operations of subtraction
Perform simple math operations of multiplication
Perform simple math operations of division
Transfer number sequences from a source into a column
Compare numbers
Perform math operations using single and multiple digit numbers
Use a calculator
Perform mathematical operations with fractions
Perform mathematical operations with decimals
Make rough estimates
Figure averages
Perform math operations using signed (positive and negative) numbers
Solve ratio problems
Multiply and factor algebraic expressions
Solve problems with graphs
Solve percent problems
Change numbers from percentages into decimals and back
Change numbers from fractions into decimals and back
Solve formula calculations with one unknown
Perform math operations using exponential numbers
Measure angles
Basic Measurement
Record measurements, using appropriate unit notations (feet, yards, etc.)
Read and use the scale of a drawing
Use tools to measure quantities and solve problems involving measurements
Measure temperature to within 1 degree Fahrenheit
Find the dimensions of an object from a scale drawing
Read measurements taken with common measuring tools
Read, interpret, and use size-scale relationships
Measure area (square inches, square centimeters, etc.)
Measure volume (cubic inches, liters, etc.)
Make simple scale drawings
Estimate and approximate measurements
Measure linear distances (length, width, etc.)
Find distances and directions on land maps
Calculate the perimeter and areas of common figures

General Knowledge Ordered by Importance for Building Commissioning (Cx) Professionals

General Knowledge
Basic Measurement (continued)
Read and apply coefficient measurements indicated in a table or chart
Measure weights using devices calibrated in pounds
Measure length to 1/4 of an inch
Measure length to 1/8 of an inch
Measure board feet
Convert measurements from one unit to another (English to Metric, etc.)
Measure weights using devices calibrated in ounces
Measure length to 1/16 of an inch
Communications
Write reports
Ask questions
Communicate using the vocabulary/terminology of a related trade
Communicate with co-workers and/or business people verbally (face-to-face)
Communicate with co-workers and/or business people verbally (telephone, radio)
Listen
Communicate with co-workers and/or business people in writing (letters, memos)
Read and follow directions found in equipment manuals and code books
Read and interpret directions found on labels, packages, or instruction sheets
Read drawings and specifications sheets
Summarize information
Explain procedures
Follow verbal job instructions
Participate in brainstorming
Present to others
Read flowcharts
Research information
Write words and numbers legibly
Evaluate solutions
Find information in references (Machinery handbook, tap/drill charts, etc.)
Read codes (building codes, electrical codes, standards, etc.)
Read information from tables and graphs (bar, circle, etc.)
Speak to large groups
Evaluate options/alternatives
Find information in catalogs
Read and follow a map, chart, plan, etc.
Apply assertiveness
Read statistical data
Compare names

Skills and Abilities Appearing in DACUM Chart of Building Commissioning (Cx) Professionals

Skills and Abilities	
Ability to assess building performance	Ability to assess timeframes for construction and commissioning
Ability to communicate technical information to others	Ability to conduct a needs assessment
Ability to conduct a root cause analysis	Ability to create a matrix
Ability to create checklists	Scheduling skills
Ability to deal with difficult people	Ability to determine appropriate sampling procedures
Ability to determine manpower requirements from scope of work	Ability to prioritize
Ability to distinguish between systems, equipment, and components	Ability to identify specialty workers needed
Ability to read and interpret construction documents	Ability to interpret scope of work
Ability to interpret the TAB report	Ability to interpret trends
Ability to read and interpret utility bills, rate structures, and utility contracts	Ability to perform document discovery
Ability to photograph evidence	Ability to review controls graphics
Ability to serve as a mediator between owners, contractors and others	Ability to train others
Ability to use collaborative meeting tools (e.g., web conferencing, teleconferences)	Ability to work with difficult people
Ability to write meeting minutes	Analytical skills
Basic math skills	Basic accounting skills
Commissioning plan development skills	Computer skills
Construction skills	Cost estimating skills
Documentation skills	Facilitation skills
Financial skills (ROI, etc.)	Follow-up techniques
Forensic skills	Interpersonal skills
Interviewing skills	Investigation skills
Leadership skills	Listening skills
Management skills	Meeting management skills
Multimedia skills	Negotiation skills
Organizational skills	Patience
Persistence	Physical attributes* (see list)
Physical mobility	Plan reading skills
Presentation skills	Project management skills
Reading ability	Report writing skills
Research skills	Scheduling skills
Team building skills	Time management skills
Troubleshooting skills	Verbal communication skills
Written communication skills	

APPENDIX G: REFERENCE LINKS

Credentialing Opportunities OnLine (COOL) Sites:

- Army – https://www.cool.army.mil/
- Navy – https://www.cool.navy.mil/usn/index.htm
- Marine Corps – https://www.cool.navy.mil/usmc/index.htm
- Air Force – https://afvec.langley.af.mil/afvec/Public/COOL/Default.aspx

Department of Labor O*NET – www.onetonline.org

APPENDIX H: O*NET MILITARY FIELD CROSSWALK

Architectural and Engineering Managers

114X– Special Operations URL, Navy, Officer

122X– Naval Reactors Engineer (RL), Navy, Officer

1361– Engineer Assistant, Marine Corps, Enlisted

144X– Engineering Duty Officer-Ship Engineering, Navy, Officer

150X– Aerospace Engineering Duty Officer (06 and above), Navy, Officer

151X– Aerospace Engineering Duty Officer requiring Aerospace Engineering Specialty, Navy, Officer

167X– Merchant Marine, Engineering SDO, Navy, Officer

18C– Special Forces Engineer Sergeant, Army, Enlisted

1A2X1– Aircraft Loadmaster, Air Force, Enlisted

3E5X1– Engineering, Air Force, Enlisted

3E6X1– Operations Management, Air Force, Enlisted

510X– Civil Engineering Officer, Navy, Officer

648X– Explosive Ordnance Disposal LDO, Navy, Officer

653X– Civil Engineering Corps LDO, Navy, Officer

717X– Special Warfare Combatant Craft Technician CWO, Navy, Officer

748X– Explosive Ordnance Disposal Technician CWO, Navy, Officer

753X– Civil Engineering Corps CWO, Navy, Officer

EA– EA-Engineering Aide, Navy, Enlisted

Construction Managers

120A– Construction Engineering Technician, Army, Warrant Officer

12A– Engineer Senior Sergeant, Army, Enlisted

12C– Bridge Crewmember, Army, Enlisted

12D– Diver, Army, Enlisted

12H– Construction Engineering Supervisor, Army, Enlisted

1361– Engineer Assistant, Marine Corps, Enlisted

1371– Combat Engineer, Marine Corps, Enlisted

18C– Special Forces Engineer Sergeant, Army, Enlisted

2T3X0– Vehicle And Vehicular Equipment Maintenance, Air Force, Enlisted

3E2X1– Pavements and Construction Equipment, Air Force, Enlisted

3E3X1– Structural, Air Force, Enlisted

3E5X1– Engineering, Air Force, Enlisted

3E6X1– Operations Management, Air Force, Enlisted

510X– Civil Engineering Officer, Navy, Officer

51C– Acquisition, Logistics & Technology (AL&T) Contracting NCO, Army, Enlisted

653X– Civil Engineering Corps LDO, Navy, Officer

6C0X1– Contracting, Air Force, Enlisted

753X– Civil Engineering Corps CWO, Navy, Officer

BU– BU-Builder, Navy, Enlisted

EA– EA-Engineering Aide, Navy, Enlisted

EO– EO-Equipment Operator, Navy, Enlisted

UCT_U_CON_TEC– UCT - Underwater Construction Technician, Navy, Enlisted

Electrical and Electronics Repairers, Powerhouse, Substation, and Relay

1141– Electrician, Marine Corps, Enlisted

1142– Engineer Equipment Electrical Systems Technician, Marine Corps, Enlisted

120A– Construction Engineering Technician, Army, Warrant Officer

12P– Prime Power Production Specialist, Army, Enlisted

3E0X0– Facility Systems, Air Force, Enlisted

3E0X1– Electrical Systems, Air Force, Enlisted

3E0X2– Electrical Power Production, Air Force, Enlisted

618X– Electronics Specialty LDO, Navy, Officer

628X– Electronics Specialty (Submarine) LDO, Navy, Officer

6333– Aircraft Electrical Systems Technician, EA-6, Marine Corps, Enlisted

6336– Aircraft Electrical Systems Technician, KC-130, Marine Corps, Enlisted

6337– Aircraft Electrical Systems Technician, F/A-18, Marine Corps, Enlisted

6432– Aircraft Electrical/Instrument/Flight Control Systems Technician, IMA, Marine Corps, Enlisted

6499– Mobile Facility Technician, Marine Corps, Enlisted

718X– Electronics Technician (Surface) CWO, Navy, Officer

728X– Electronics Technician (Submarine) CWO, Navy, Officer

733X– Aviation Maintenance CWO, Navy, Officer

881A– Marine Engineering Officer, Army, Warrant Officer

915A– Automotive Maintenance Warrant Officer, Army, Warrant Officer

919A– Engineer Equipment Maintenance Warrant Officer, Army, Warrant Officer

91D– Power-Generation Equipment Repairer, Army, Enlisted

AE– AE-Aviation Electrician's Mate, Navy, Enlisted

CE– CE-Construction Electrician, Navy, Enlisted

EM (NUC)– EM (NUC)-Electrician's Mate/ Nuclear, Navy, Enlisted

EM– EM-Electrician's Mate, Navy, Enlisted

ET (NUC)– ET (NUC)-Electronic Technician - Nuclear, Navy, Enlisted

GSE– GSE-Gas Turbine System Technician Electrical, Navy, Enlisted

MUSE_MUSE_TEC– MUSE - Mobile Utilities Support Equipment Technician, Navy, Enlisted

Electrical Engineering Technologists

12R– Interior Electrician, Army, Enlisted

15F– Aircraft Electrician, Army, Enlisted

3E0X1– Electrical Systems, Air Force, Enlisted

3E0X2– Electrical Power Production, Air Force, Enlisted

Electrical Power-Line Installers and Repairers

0612– Tactical Switching Operator, Marine Corps, Enlisted

1141– Electrician, Marine Corps, Enlisted

12Q– Powerline Distribution Specialist (RC), Army, Enlisted

25L– Cable Systems Installer-Maintainer, Army, Enlisted

3D1X7– Cable and Antenna Systems, Air Force, Enlisted

3E0X0– Facility Systems, Air Force, Enlisted

3E0X1– Electrical Systems, Air Force, Enlisted

3E0X2– Electrical Power Production, Air Force, Enlisted

CE– CE-Construction Electrician, Navy, Enlisted

EM (NUC)– EM (NUC)-Electrician's Mate/ Nuclear, Navy, Enlisted

EM– EM-Electrician's Mate, Navy, Enlisted

ET (NUC)– ET (NUC)-Electronic Technician - Nuclear, Navy, Enlisted

GSE– GSE-Gas Turbine System Technician Electrical, Navy, Enlisted

Heating and Air Conditioning Mechanics and Installers

1161– Refrigeration and Air Conditioning Technician, Marine Corps, Enlisted

1169– Utilities Chief, Marine Corps, Enlisted

12K– Plumber, Army, Enlisted

2A6X2– Aerospace Ground Equipment, Air Force, Enlisted

2M0X3– Missile And Space Facilities, Air Force, Enlisted

3E1X1– Heating, Ventilation, Air Conditioning, and Refrigeration, Air Force, Enlisted

6073– Aircraft Maintenance Support Equipment Electrician/Refrigeration Mechanic, Marine Corps, Enlisted

6499– Mobile Facility Technician, Marine Corps, Enlisted

91C– Utilities Equipment Repairer, Army, Enlisted

91J– Quartermaster and Chemical Equipment Repairer, Army, Enlisted

AS– AS-Aviation Support Equipment Technician, Navy, Enlisted

UT– UT-Utilitiesman, Navy, Enlisted

Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters

1171– Water Support Technician, Marine Corps, Enlisted

12K– Plumber, Army, Enlisted

3E4X1– Water and Fuel Systems Maintenance, Air Force, Enlisted

FC– FC-Fire Controlman, Navy, Enlisted

UT– UT-Utilitiesman, Navy, Enlisted

Insulation Workers, Mechanical

MM– MM-Machinist's Mate, Navy, Enlisted

Operating Engineers and Other Construction Equipment Operators

0313– LAV Crewman, Marine Corps, Enlisted

0351– Infantry Assaultman, Marine Corps, Enlisted

0352– Anti-tank Missileman, Marine Corps, Enlisted

0369– Infantry Unit Leader, Marine Corps, Enlisted

0372– Critical Skills Operator, Marine Corps, Enlisted

0623– Tropospheric Scatter Radio Multi-channel Equipment Operator, Marine Corps, Enlisted

0811– Field Artillery Cannoneer, Marine Corps, Enlisted

0842– Field Artillery Radar Operator, Marine Corps, Enlisted

11B– Infantryman, Army, Enlisted

11C– Indirect Fire Infantryman, Army, Enlisted

12A– Engineer Senior Sergeant, Army, Enlisted

12B– Combat Engineer, Army, Enlisted

1345– Engineer Equipment Operator, Marine Corps, Enlisted

13B– Cannon Crewmember, Army, Enlisted

13M– Multiple Launch Rocket System (MLRS)/High Mobility Artillery Rocket System (HiMARS) Crewmember, Army, Enlisted

13R– Field Artillery Firefinder Radar Operator, Army, Enlisted

14E– Patriot Fire Control Enhanced Operator/Maintainer, Army, Enlisted

18C– Special Forces Engineer Sergeant, Army, Enlisted

19D– Cavalry Scout, Army, Enlisted

25Q– Multichannel Transmission Systems Operator-Maintainer, Army, Enlisted

2T3X0– Vehicle And Vehicular Equipment Maintenance, Air Force, Enlisted

2W1X1– Aircraft Armament Systems, Air Force, Enlisted

2W2X1– Nuclear Weapons, Air Force, Enlisted

3E2X1– Pavements and Construction Equipment, Air Force, Enlisted

91L– Construction Equipment Repairer, Army, Enlisted

ABH– ABH-Aviation Boatswain's Mates, Aircraft Handling, Navy, Enlisted

EO– EO-Equipment Operator, Navy, Enlisted

Pipe Fitters and Steamfitters

1169– Utilities Chief, Marine Corps, Enlisted

1171– Water Support Technician, Marine Corps, Enlisted

12K– Plumber, Army, Enlisted

2T3X0– Vehicle And Vehicular Equipment Maintenance, Air Force, Enlisted

3E1X1– Heating, Ventilation, Air Conditioning, and Refrigeration, Air Force, Enlisted

3E4X0– Infrastructure Systems, Air Force, Enlisted

3E4X1– Water and Fuel Systems Maintenance, Air Force, Enlisted

DC– DC-Damage Controlman, Navy, Enlisted

FC– FC-Fire Controlman, Navy, Enlisted

HT– HT-Hull Maintenance Technician, Navy, Enlisted

MM– MM-Machinist's Mate, Navy, Enlisted

UT– UT-Utilitiesman, Navy, Enlisted

Refrigeration Mechanics and Installers

1161– Refrigeration and Air Conditioning Technician, Marine Corps, Enlisted

1169– Utilities Chief, Marine Corps, Enlisted

2A6X2– Aerospace Ground Equipment, Air Force, Enlisted

2T3X0– Vehicle And Vehicular Equipment Maintenance, Air Force, Enlisted

3E1X1– Heating, Ventilation, Air Conditioning, and Refrigeration, Air Force, Enlisted

3E4X0– Infrastructure Systems, Air Force, Enlisted

6073– Aircraft Maintenance Support Equipment Electrician/Refrigeration Mechanic, Marine Corps, Enlisted

6499– Mobile Facility Technician, Marine Corps, Enlisted

91C– Utilities Equipment Repairer, Army, Enlisted

AS– AS-Aviation Support Equipment Technician, Navy, Enlisted

EN– EN-Engineman, Navy, Enlisted

MM– MM-Machinist's Mate, Navy, Enlisted

UT– UT-Utilitiesman, Navy, Enlisted

Roofers

3E3X1– Structural, Air Force, Enlisted

BU– BU-Builder, Navy, Enlisted

Stationary Engineers and Boiler Operators

1142– Engineer Equipment Electrical Systems Technician, Marine Corps, Enlisted

1169– Utilities Chief, Marine Corps, Enlisted

1171– Water Support Technician, Marine Corps, Enlisted

120A– Construction Engineering Technician, Army, Warrant Officer

12P– Prime Power Production Specialist, Army, Enlisted

1A0X1– In-Flight Refueling, Air Force, Enlisted

2F0X1– Fuels, Air Force, Enlisted

2T3X0– Vehicle And Vehicular Equipment Maintenance, Air Force, Enlisted

3E0X0– Facility Systems, Air Force, Enlisted

3E0X1– Electrical Systems, Air Force, Enlisted

3E0X2– Electrical Power Production, Air Force, Enlisted

3E1X1– Heating, Ventilation, Air Conditioning, and Refrigeration, Air Force, Enlisted

3E4X0– Infrastructure Systems, Air Force, Enlisted

6074– Cryogenics Equipment Operator, Marine Corps, Enlisted

881A– Marine Engineering Officer, Army, Warrant Officer

91J– Quartermaster and Chemical Equipment Repairer, Army, Enlisted

ABE– ABE-Aviation Boatswain's Mates, Launching and Recovery Equipment, Navy, Enlisted

ABF– ABF-Aviation Boatswain's Mates, Fuels, Navy, Enlisted

EN– EN-Engineman, Navy, Enlisted

GSE– GSE-Gas Turbine System Technician Electrical, Navy, Enlisted

GSM– GSM-Gas Turbine System Technician Mechanical, Navy, Enlisted

MM (NUC)– MM (NUC)-Machinist's Mate/Nuclear, Navy, Enlisted

MM– MM-Machinist's Mate, Navy, Enlisted

MME– MME-Machinist's Mate Engineering, Navy, Enlisted

MM-ELT (NUC)– MM-ELT (NUC)-Machinist's Mate/Nuclear, Navy, Enlisted

MMW– MMW-Machinist's Mate Weapons, Navy, Enlisted

UT– UT-Utilitiesman, Navy, Enlisted