**US DOE Award: #DE-EE0003853
Energy Commissioning Agent/Auditor Online Training
Program**

Final Scientific/Technical Report

**Center for Building Knowledge
New Jersey Institute of Technology**

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Executive Summary

The original objective of this project was to create a comprehensive training and deployment program - suitable for in-person delivery in the New York metro region – focused on educating building commissioning authorities and energy auditors. The NJIT Center for Building Knowledge was to have sole responsibility for this curriculum development and deployment plan effort. Very early in the project timeline, however, the scope of the project evolved – with DOE and NETL approval - to become a collaborative effort between NJIT and Portland Energy Conservation, Inc. (PECI).

The structure of this collaboration involved PECO taking the lead on developing a comprehensive curriculum program suitable for in-person delivery, and NJIT taking the lead on turning this curriculum into a comprehensive online training program that would complement – and extend the reach of – the in-person curriculum.

NJIT proceeded on this collaborative basis over the course of the project and created - in direct collaboration with PECO - a comprehensive, “e-learning” curriculum consisting of 69 individual online lessons organized into 16 courses and four overarching modules:

- Commissioning Fundamentals (2 Courses)
- Advanced Commissioning (9 Courses)
- Energy Auditing Fundamentals (1 Courses)
- Advanced Energy Auditing (4 Courses)

The online training materials were created using Articulate authoring software and were delivered to DOE and NETL in this format. In addition, the materials were delivered to PECO and directly incorporated into the learning management system they developed over the course of the project. The material will be deployed by PECO through this system – titled “PECO Building Efficiency Training Programs” (learn.peci.org) – as part of the commercialization plan developed under their award.

Background

The Center for Building Knowledge at the New Jersey Institute of Technology (NJIT) submitted a proposal under US DOE Funding Opportunity Announcement DE-FOA-0000118 to create “Energy Commissioning Agent/Auditor Training in the New York Metro Region.” The main objectives of project were to create a comprehensive training program (suitable for in-person delivery in the New York metro region), together with a plan – including a comprehensive marketing plan - for deploying the program in the region. The proposal was successful and NJIT received an award (#DE-EE0003853) in June 2010.

After the award was finalized, NJIT entered into discussions with another awardee – Portland Energy Conservation, Inc. (PECI) – and determined that both organizations had submitted similar scopes of work that focused on developing curricula for commissioning/auditing training. While these scopes differed in their details, both addressed the core competencies

that their target audiences would need to become effective commissioning authorities/energy auditors. Although the NJIT proposal did include a modest amount of online curriculum development – to assist in a proposed “train-the-trainer” program – the emphasis was much more heavily focused on creating curricula designed for in-person training. PECl proposed a blended approach with a primary focus on in-person, classroom/lab instruction supplemented with a limited amount of e-learning.

The NJIT Center for Building Knowledge has long had a strong capability in creating online training for the building community and, at the time of award, had recently completed projects for Oak Ridge National Laboratory, the California Energy Commission, the National Institute of Building Sciences and New Jersey’s Clean Energy Program. While NJIT didn’t propose online training as a core element of its original proposal, after award it began to consider how it might put its experience in this field to work in the service of the “Energy Commissioning Agents/Auditors” segment of DOE’s program.

Through a series of discussions, NJIT and PECl identified a potential new approach that could bring a stronger online component into the overall program while, at the same time, broadening and deepening the curriculum for Commissioning Authority/Energy Auditor training. Specifically, NJIT and PECl agreed to collaborate – if NETL/DOE would approve - with PECl taking the lead on developing a comprehensive curriculum program suitable for in-person delivery and NJIT taking the lead on turning the appropriate sections of this curriculum into a more comprehensive online training program that complements – and extends the reach of – the in-person curriculum. Such an approach would build on the strengths of both organizations and could have significant synergistic effects that would benefit the program overall by providing superior curriculum materials and a high quality, very cost-effective online training platform. This approach would also increase the accessibility and affordability of the program, significantly enhancing its potential for widespread commercialization at a national scale.

NJIT and PECl presented these ideas to DOE and NETL personnel immediately after the project kick-off meeting in early October 2010 at NETL headquarters and they were approved. As a consequence, NJIT prepared and submitted an updated Statement of Project Objectives and Project Management Plan in late November 2010. Both were also approved, and NJIT proceeded to undertake the scope of work described in these documents.

Project Goals and Objectives

Per the updated SOPO and PMP, the overall goal of this project was to create a comprehensive e-learning program that could be used to rapidly and effectively train a new cohort of energy commissioning authorities/energy auditors who, in the words of the FOA, “...know how to properly run and tune building systems.” The e-learning program would directly address the skills that commissioning authorities and energy auditors need in order to optimize the performance of new and existing buildings, including:

- Testing and performing diagnostics of energy using systems required to identify opportunities for energy efficiency

- Estimating energy savings and costs related to the implementation of energy improvement measures
- Providing guidance and oversight on implementation of energy efficiency measures
- Identifying and providing guidance for correcting design issues in new high efficiency systems
- Commissioning for energy efficiency and improved performance
- Monitoring and verifying system performance to ensure the energy performance goals are reached and benefits persist.

The project targeted those entering the job fields for energy auditors and CxAs.

Project Accomplishments

As called for in its updated SOPO and PMP documents, NJIT successfully developed and helped deploy a comprehensive, online e-learning training program focused on commissioning authorities and energy auditors. The program comprises more than twenty hours of online training content and consists of 69 individual lessons, organized into the following modules and courses:

Cx Module 1: Commissioning Fundamentals

CX 1.1: New Construction Building Commissioning

CX 1.2: Existing Building Commissioning

Cx Module 3: Advanced Commissioning**

CX 3.2: Design Review

CX 3.3: Mechanical System Analysis - Air Distribution

CX 3.4: Mechanical System Analysis – Hydronic

CX 3.5: Mechanical System Analysis – Tab

CX 3.6: Electrical Analysis

CX 3.7: Control System Analysis – DDC

CX 3.8: Control System Analysis - Air Handling & Hydronic Systems

CX 3.9: Functional Performance Testing

CX 3.10: System Evaluation

EA Module 1: Energy Auditing Fundamentals

EA 1.1: Intro to Energy Auditing

EA Module 3: Advanced Energy Auditing**

EA 3.1: Building Energy Assessment

EA 3.2: Energy Audit Procedures

EA 3.3: Faculty Evaluation

EA 3.4: Energy Audits

(** Note: There is a skip in the numbering sequence in both the Cx and EA curricula. Module 2 is “missing.” This is because the courses for this module were created independently by PECL as part of the overall curriculum package it developed and is bringing to market. In this final scientific/technical report, NJIT is only reporting on the work it accomplished under Award #DE-EE0003853, which includes Module 1 and 3, but not Module 2.)

The courses were created using Articulate authoring software, and each of the 69 lessons was published as a SCORM-compliant object suitable for incorporation into an online learning management system (LMS). The project's final deliverable to NETL and the DOE was the Articulate files, organized and presented as a series of url links to a server hosting the individual files. A matrix listing each lesson and its associated url is provided as Attachment A to this report. A representative section of the matrix and two screen shots from lesson Cx 3.3.1 are provided here and in Attachment B for reference.

As part of its collaboration with PECI, NJIT also delivered the Articulate files to PECI for incorporation into the learning management system that they developed for the project and that will be using to deploy their comprehensive online curriculum. This curriculum includes the Module 1 and 3 courses created by NJIT, plus Module 2, developed by PECI, which is focused on mechanical engineering fundamentals.

PECI has successfully incorporated NJIT's courses and lessons into their learning management system and the curriculum is now fully operational and ready for deployment at learn.peci.org. Representative screen shots are provided below for reference.

By developing a comprehensive online training program for commissioning authorities and energy auditors and then delivering it to PECl in a form that could be – and was - directly inserted into their learning management system, NJIT successfully accomplished all the goals and objectives for the project.

Project Activity Summary

In accordance with the terms of its revised and updated Statement of Project Objectives and Program Management Plan, NJIT – in close collaboration with PECl – undertook the following activities over the course of the project.

- Created and successfully followed a Project Management Plan for the work effort.
- Developed and implemented a comprehensive Integration Plan, focused on how to instructionally design and, ultimately, produce online versions of the core content material being created by PECl. The plan covered both eventual outcomes and a step-by-step collaboration plan (between NJIT and PECl) for achieving these outcomes.
- Conducted a Curriculum Needs Analysis focused on strengths and deficiencies in existing, online training for commissioning authorities and energy auditors.
- Based on the results of the curriculum needs analysis, and in close collaboration with PECl, developed a comprehensive Development Plan for creating the online training program (what came to be termed, at this point in the project, the “e-learning” program). The plan laid out instructional goals, learning objectives and specific levels of “e-enhancement” planned for each individual lesson, together with recommended strategies for achieving these levels.
- Produced the comprehensive “e-learning” curriculum outlined in the curriculum development plan. Full production included 69 individual online lessons, organized into four modules and sixteen courses (see Attachment A for a summary of course and lesson titles).
- Assisted PECl in its efforts to define and promote a Certification/Accreditation program and a Commercialization/Sustainability plan for the curriculum that PECl will bring to market. This comprehensive, “blended-learning” curriculum includes NJIT’s e-learning contribution, plus additional online and in-person resources.

While development of the core curriculum content took slightly longer than originally anticipated, the project did not encounter any major problems and the final online curriculum that was delivered successfully met the goals and objectives of the project.

Products Developed

NJIT's core deliverable under the project was a comprehensive series of SCORM-compliant, online lessons – focused on commissioning authority and energy auditor training – suitable for incorporation into a learning management system (LMS). In addition, NJIT collaborated closely with PECI to incorporate these lessons into PECI's LMS and prepare them for deployment.

URL's for all the lessons were submitted to NETL and DOE as NJIT's final deliverable for the project. (See Attachment A for a list of all the lessons and their associated URL's.)

PECI's learning management system – which incorporates all NJIT's delivered lessons – can be accessed at: learn.peci.org

Attachment A

E-Learning Curriculum Matrix

The modules and courses developed by NJIT under this scope of work were created using Articulate authoring software. Each of the curriculum's 69 lessons was published as a SCORM-compliant object suitable for incorporation into an online learning management system (LMS). The project's final deliverable to NETL and the DOE was the Articulate files, organized and presented as a series of url links to a server hosting the individual files. The following is a representation of the matrix delivered to NETL and DOE, listing all the modules, courses and lessons developed by NJIT and their associated url's. The only difference between this matrix and the original is that the url links are not "live."

Course, Lesson #	Name	Run time in minutes	Completed Player link
CX MODULE 1			
	COURSE CX 1.1: New Construction Building Commissioning		
CX 1.1.1	Pre Design Phase	12:09	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.1_Pre-DesignPhase/player.html
CX 1.1.2	Design Phase Commissioning Plan	13:04	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.2_DesignPhase-CxPlan/player.html
CX 1.1.3	Design Review	13:23	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.3_DesignReview/player.html
CX 1.1.4	Construction Phase- Submittal Review	13:02	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.4_CP-SubmittalReview/player.html
CX 1.1.5	Construction Phase Commissioning- S	16:08	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.5_CP-SiteObservation/player.html
CX 1.1.6	Construction Phase- Functional Perform	14:08	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.6_CP-FunctionalPerformanceTesting/player.html
CX 1.1.7	Construction Phase- SM and O&M Doc	17:51	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.7_CP-DocumentsReview/player.html
CX 1.1.8	Operation and Maintenance Training	17:38	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.8_OperationTraining/player.html
CX 1.1.9	Operation/ Occupancy Phase	6:52	http://media.buildingmedia.com/projects2/peci/SCO/CX1.1.9_OperationOccupancyPhase/player.html
	Total Course Time	2:04:15	
COURSE CX 1.2: Existing Building Commissioning			
CX 1.2.1	Scoping/Planning Phase- ID Goals and	26:13	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.1_PP-Goals/player.html
CX 1.2.2	Scoping/Planning Phase- Building Walk	22:13	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.2_PP-BuildingWalkthrough/player.html
CX 1.2.3	EBCx Plan	23:59	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.3_EBCxPlan/player.html
CX 1.2.4	Investigation Phase- Reviewing Docs a	23:17	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.4_IP-ReviewingDocs/player.html
CX 1.2.5	Investigation Phase- Analyzing Facility	20:06	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.5_IP-AnalyzingFacility/player.html
CX 1.2.6	Investigation Phase- Testing, Monitorin	32:54	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.6_IP-TestingMonitoring/player.html
CX 1.2.7	Implementation Phase	24:45	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.7_ImplPhase/player.html
CX 1.2.8	Handoff Phase- Training System, Man	21:30	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.8_HandoffPhase/player.html
CX 1.2.9	Ongoing Commissioning Phase	22:33	http://media.buildingmedia.com/projects2/peci/SCO/CX1.2.9_OngoingCxPhase/player.html
	Total Course Time	3:37:30	
CX MODULE 3			
	COURSE CX 3.2: Design Review		
CX 3.2.1	Mechanical Design Review	32:29	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.1_MechanicalDesignReview/player.html
CX 3.2.2	Plumbing Design Review	07:50	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.2_PlumbingDesignReview/player.html
CX 3.2.3	Electrical Design Review	22:28	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.3_ElectricalDesignReview/player.html
	Total Course Time	1:02:47	
COURSE CX 3.3: Mechanical System Analysis - Air Distribution			

CX 3.3.1	Analysis of Packages HVAC Equipment	18:16	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.1_AnalysisofPackagedHVACEquipment/player.html
CX 3.3.2	Analysis of Air Moving Equipment	15:47	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.2_AnalysisofAirMovingEquipment/player.html
CX 3.3.3	Analysis of Duct Design	19:51	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.3_AnalysisofDuctDesign/player.html
CX 3.3.4	Analysis of Space Airflow and General Exhaust	27:57	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.4_AnalysisofSpaceAirflowandGeneralExhaust/player.html
	Total Course Time	1:21:51	
COURSE CX 3.4: Mechanical System Analysis - Hydronic			
CX 3.4.1	Analysis of Chilled Water Systems	15:48	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.1_AnalysisofChilledWaterSystems/player.html
CX 3.4.2	Analysis of Hot Water Heating Systems	09:34	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.2_AnalysisofHotWaterHeatingSystems/player.html
CX 3.4.3	Analysis of Hydronic Piping Systems	08:45	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.3_AnalysisofHydronicPipingSystems/player.html
CX 3.4.4	Analysis of Hydronic Pumping Systems	10:07	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.4_AnalysisofHydronicPumpingSystemsTerminalUnits/player.html
	Total Course Time	44:14	
COURSE CX 3.5: Mechanical System Analysis - Tab			
CX 3.5.1	Air System Testing, Adjusting and Balancing	25:36	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.1_AirSystemTestingAdjustingandBalancing/player.html
CX 3.5.2	Air Testing, Adjusting and Balancing Issues	13:13	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.2_AirTestingAdjustingandBalancingIssues/player.html
CX 3.5.3	Water Testing, Adjusting and Balancing	18:32	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.3_WaterTesting/player.html
CX 3.5.4	Water Testing, Adjusting and Balancing Issues	12:07	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.4_WaterTestingIssues/player.html
	Total Course Time	1:09:28	
COURSE CX 3.6: Electrical Analysis			
CX 3.6.1	Analysis of Electrical Distribution Systems	15:10	http://media.buildingmedia.com/projects2/peci/SCO/CX3.6.1_AnalysisofElectricalDS/player.html
CX 3.6.2	Analysis of Lighting Control Systems	19:11	http://media.buildingmedia.com/projects2/peci/SCO/CX3.6.2_AnalysisofLightingCS/player.html
CX 3.6.3	Analysis of Photovoltaic Systems	11:18	http://media.buildingmedia.com/projects2/peci/SCO/CX3.6.3_AnalysisofPhotovoltaicSystems/player.html
	Total Course Time	45:39	
COURSE CX 3.7: Control System Analysis - DDC			
CX 3.7.1	Direct Digital Control Systems	23:42	http://media.buildingmedia.com/projects2/peci/SCO/CX3.7.1_DDCSystems/player.html
CX 3.7.2	Energy Efficiency Control Strategies	22:02	http://media.buildingmedia.com/projects2/peci/SCO/CX3.7.2_EnerEffControl/player.html
CX 3.7.3	DDC Installation and Operation Issues	30:02	http://media.buildingmedia.com/projects2/peci/SCO/CX3.7.3_DDCInstallationIssues/player.html
CX 3.7.4	DDC Sensor Installation	18:59	http://media.buildingmedia.com/projects2/peci/SCO/CX3.7.4_DDCSensorInstallation/player.html
	Total Course Time	1:34:45	
CX 3.8: Control System Analysis - Air Handling & Hydronic Systems			
CX 3.8.1	Analysis of Duct Station and VAV Terminal Reheat Supply Air Temperature Control	23:20	http://media.buildingmedia.com/projects2/peci/SCO/CX3.8.2_AnalysisofVAVReheatSupplyAirTemperatureControl/player.html
CX 3.8.2	Analysis of VAV Reheat and Supply Air Temperature Control	23:20	http://media.buildingmedia.com/projects2/peci/SCO/CX3.8.2_AnalysisofVAVReheatSupplyAirTemperatureControl/player.html
CX 3.8.3	Economizer Control	25:03	http://media.buildingmedia.com/projects2/peci/SCO/CX3.8.3_EconomizerControl/player.html
CX 3.8.4	Analysis of Outside Air Control	24:43	http://media.buildingmedia.com/projects2/peci/SCO/CX3.8.4_AnalysisofOutsideAirControl/player.html
	Total Course Time	1:37:26	
COURSE CX 3.9: Functional Performance Testing			

CX 3.9.1	FPT Development: HVAC	26:07	http://media.buildingmedia.com/projects2/peci/SCO/CX4.1.1_FPTDevelopmentHVAC/player.html
CX 3.9.2	FTP Development: Plumbing	26:19	http://media.buildingmedia.com/projects2/peci/SCO/CX4.1.2_FTPDevelopmentPlumbing/player.html
CX 3.9.3	FPT Development: Electrical	30:36	http://media.buildingmedia.com/projects2/peci/SCO/CX4.1.3_FPTDevelopmentElectrical/player.html
CX 3.9.4	FPT- Development: Lighting Controls	24:16	http://media.buildingmedia.com/projects2/peci/SCO/CX4.1.4_FTPDevelopmentLightingControls/player.html
	Total Course Time	1:47:18	
	COURSE CX 3.10: System Evaluation		
CX 3.10.1	Monitoring and Trending	37:58	http://media.buildingmedia.com/projects2/peci/SCO/CX4.2.1_MonitoringandTrending/player.html
CX 3.10.2	Analyzing Monitoring and Trending Results	18:11	http://media.buildingmedia.com/projects2/peci/SCO/CX4.2.2_AnalyzingMonitoringandTrendingResults/player.html
CX 3.10.3	M & V Fundamentals	30:08	http://media.buildingmedia.com/projects2/peci/SCO/CX4.2.3_M&VFundamentals/player.html
	Total Course Time	1:26:17	
	EA MODULE 1		
	COURSE EA 1.1: Intro to Energy Auditing		
EA 1.1.1.	Energy Auditing Process: Goals & Objectives	13:11	http://media.buildingmedia.com/projects2/peci/SCO/EA1.1.1_EnergyAuditingProcessGoals&Objectives/player.html
EA 1.1.2.	Energy Auditing Process: Preliminary Energy Use Analysis	32:46	http://media.buildingmedia.com/projects2/peci/SCO/EA1.1.2_EnergyAuditingProcessPreliminaryEnergyUseAnalysis/player.html
EA 1.1.3.	Energy Auditing Process: Audit Level I	26:07	http://media.buildingmedia.com/projects2/peci/SCO/EA1.1.3_EnergyAuditingProcessAuditLevelI/player.html
EA 1.1.4.	Energy Auditing Process: Audit Level II	33:21	http://media.buildingmedia.com/projects2/peci/SCO/EA1.1.4_EnergyAuditingProcessAuditLevelII/player.html
EA 1.1.5.	Energy Auditing Process: Audit Level III	31:44	http://media.buildingmedia.com/projects2/peci/SCO/EA1.1.5_EnergyAuditingProcessAuditLevelIII/player.html
	Total Course Time	2:17:09	
	EA MODULE 3		
	COURSE EA 3.1: Building Energy Assessment		
EA 3.1.1	Preliminary Energy Analysis - Summary Development	16:59	http://media.buildingmedia.com/projects2/peci/SCO/EA3.1.1_PreliminaryEnergyAnalysis-SummaryDevelopment/player.html
EA 3.1.2	Preliminary Energy Analysis - Document Review	15:43	http://media.buildingmedia.com/projects2/peci/SCO/EA3.1.2_PreliminaryEnergyAnalysis-DocumentReview/player.html
EA 3.1.3	Preliminary Energy Analysis - Identifying FIMs	17:40	http://media.buildingmedia.com/projects2/peci/SCO/EA3.1.3_PreliminaryEnergyAnalysis-IdentifyingFIMs/player.html
	Total Course Time	49:82	
	COURSE EA 3.2: Energy Audit Procedures		
EA 3.2.1	Energy Auditing Instructions	15:56	http://media.buildingmedia.com/projects2/peci/SCO/EA3.2.1_EnergyAuditingInstructions/player.html
EA 3.2.2	Faculty Inspection: Interviewing Staff and Occupants	20:19	http://media.buildingmedia.com/projects2/peci/SCO/EA3.2.2_FacultyInspectionInterviewingStaffandOccupants/player.html
EA 3.2.3	Faculty Inspection: Building Walk-Through	16:12	http://media.buildingmedia.com/projects2/peci/SCO/EA3.2.3_FacultyInspectionBuildingWalk-Through/player.html
EA 3.2.4	M & V Fundamentals	30:08	http://media.buildingmedia.com/projects2/peci/SCO/EA3.2.3_M&VFundamentals/player.html
	Total Course Time	1:22:35	
	COURSE EA 3.3: Faculty Evaluation		
EA 3.3.1	Evaluating Envelope Systems	12:33	http://media.buildingmedia.com/projects2/peci/SCO/EA3.3.1_EvaluatingEnvelopeSystems/player.html
EA 3.3.2	Evaluating HVAC&R Systems	36:00	http://media.buildingmedia.com/projects2/peci/SCO/EA3.3.2_EvaluatingHVAC&RSystems/player.html
EA 3.3.3	Evaluating Domestic Hot Water Systems	14:33	http://media.buildingmedia.com/projects2/peci/SCO/EA3.3.3_EvaluatingDomesticHotWaterSystems/player.html
EA 3.3.4	Evaluating Electrical Systems	27:00	http://media.buildingmedia.com/projects2/peci/SCO/EA3.3.4_EvaluatingElectricalSystems/player.html

EA 3.3.5	Evaluating Building Automation Control Systems	25:10	http://media.buildingmedia.com/projects2/peci/SCO/EA3.3.5_EvaluatingBuildingAutomationControlSystems/player.html
	Total Course Time	1:55:16	
	COURSE 3.4: Energy Audits		
EA 3.4.1	Energy Audit Analysis of Process and Results	16:02	http://media.buildingmedia.com/projects2/peci/SCO/EA3.4.1_EnergyAuditAnalysisofProcessandResults/player.html
EA 3.4.2	Energy Audit Implementation Costs and Benefits	24:07	http://media.buildingmedia.com/projects2/peci/SCO/EA3.4.2_EnergyAuditImplementationCostsandBenefits/player.html
	Total Course Time	40:09	

Attachment B

Representative Articulate and learn.peci.org Screen Shots

The following shows a section of the E-Learning Curriculum Matrix developed by NJIT, together with two screen shots from the Articulate file for lesson Cx 3.3.1 (“Analysis of Packaged HVAC Equipment”). The images illustrate the “look and feel” of the online curriculum content developed by NJIT over the course of the project. The full file for this lesson – along with 68 other lessons - were delivered to DOE/NETL and to PECI, where they were incorporated into the “PECI Building Efficiency Training Programs” learning management system (learn.peci.org). Two sample screen shots from the learning management system – and referencing the “Analysis of Packaged HVAC Equipment” lesson – are also provided for reference.

	A	B	C	D	E	F	G
82	CX-EA 2.12.1	SE 212-01e	Control System Fundamentals Lesson 1: Control System Terms	46	L1.5	26:16	http://media.buildingmedia.com/projects2/peci/test2/se212-01e_DD/player.html
83	CX-EA 2.12.2	SE 212-02e	Types of Control Systems	44	L1.5	28:16	http://media.buildingmedia.com/projects2/peci/test2/se212-02e_DD/player.html
84	CX-EA 2.12.3	SE 212-03e	Modes of Operation	46	L1.5	24:53	http://media.buildingmedia.com/projects2/peci/test2/se212-03e_DD/player.html
85	CX-EA 2.12.4	SE 212-04e	Control System Elements	49	L2	23:31	http://media.buildingmedia.com/projects2/peci/test2/se212-04e_DD/player.html
86			COURSE CX-EA 2.13: Control Systems				
87	CX-EA 2.13.1	SE 213-01e	DDC Systems	36	L1	15:12	http://media.buildingmedia.com/projects2/peci/test2/se213-01e_DD/player.html
88	CX-EA 2.13.2	SE 213-02e	DDC Systems 2	41	L1	24:17	http://media.buildingmedia.com/projects2/peci/test2/se213-02e_DD/player.html
89	CX-EA 2.13.3	SE 213-03e	Control System Drawings and Documents	35	L2	20:32	http://media.buildingmedia.com/projects2/peci/test2/se213-03e_DD/player.html
90			CX MODULE 3				
91			COURSE CX 3.2: Design Review				
92	CX 3.2.1	SPA 302-01e	Mechanical Design Review	43	L1.5	32:29	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.1_MechanicalDesignReview/player.html
93	CX 3.2.2	SPA 302-02e	Plumbing Design Review	14	L1	07:50	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.2_PlumbingDesignReview/player.html
94	CX 3.2.3	SPA 302-03e	Electrical Design Review	42	L1.5	22:28	http://media.buildingmedia.com/projects2/peci/SCO/CX3.2.3_ElectricalDesignReview/player.html
95			COURSE CX 3.3: Mechanical System Analysis - Air Distribution				
96	CX 3.3.1	SPA 303-01e	Analysis of Packages HVAC Equipment	37	L2	18:16	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.1_AnalysisofPackagedHVACEquipment/player.html
97	CX 3.3.2	SPA 303-02e	Analysis of Air Moving Equipment	42	L1.5	15:47	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.2_AnalysisofAirMovingEquipment/player.html
98	CX 3.3.3	SPA 303-03e	Analysis of Duct Design	41	L1.5	19:51	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.3_AnalysisofDuctDesign/player.html
99	CX 3.3.4	SPA 303-04e	Analysis of Space Airflow and General Exhaust	41	L1.5	27:57	http://media.buildingmedia.com/projects2/peci/SCO/CX3.3.4_AnalysisofSpaceAirflowandGeneralExhaust/player.html
100			COURSE CX 3.4: Mechanical System Analysis - Hydronic				
101	CX 3.4.1	SPA 304-01e	Analysis of Chilled Water Systems	39	L2	15:48	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.1_AnalysisofChilledWaterSystems/player.html
102	CX 3.4.2	SPA 304-02e	Analysis of Hot Water Heating Systems	25	L2	09:34	http://media.buildingmedia.com/projects2/peci/SCO/CX3.4.2_AnalysisofHotWaterHeatingSystems/player.html
103	CX 3.4.3	SPA 304-03e	Analysis of Hydronic Piping Systems	32	L1.5	16:00 est	
104	CX 3.4.4	SPA 304-04e	Analysis of Hydronic Pumping Systems and Terminal Units	26	L1	13:00 est	
105			COURSE CX 3.5: Mechanical System Analysis - Tab				
106	CX 3.5.1	SPA 305-01e	Air System Testing, Adjusting and Balancing	37	L2	25:36	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.1_AirSystemTestingAdjustingandBalancing/player.html
107	CX 3.5.2	SPA 305-02e	Air Testing, Adjusting and Balancing Issues	34	L2	13:13	http://media.buildingmedia.com/projects2/peci/SCO/CX3.5.2_AirTestingAdjustingandBalancingIssues/player.html
108	CX 3.5.3	SPA 305-03e	Water Testing, Adjusting and Balancing	31	L2	15:30 est	
109	CX 3.5.4	SPA 305-04e	Water Testing, Adjusting and Balancing Issues	25	L1	12:30 est	
110			COURSE CX 3.6: Electrical Analysis				
111	CX 3.6.1	SPA 306-01e	Analysis of Electrical Distribution Systems Deficiencies and Resolutions	35	L1	17:30 est	
112	CX 3.6.2	SPA 306-02e	Analysis of Lighting Control Systems	34	L1	17:00 est	
113	CX 3.6.3	SPA 306-03e	Analysis of Photovoltaic Systems	33	L1	16:30 est	
114			COURSE CX 3.7: Control System Analysis - DDC				
115	CX 3.7.1	SPA 307-01e	Direct Digital Control Systems	46	L1	23:00 est	
116	CX 3.7.2	SPA 307-02e	Energy Efficiency Control Strategies	44	L1	22:00 est	
117	CX 3.7.3	SPA 307-03e	DDC Installation and Operation Issues	46	L1	23:00 est	
118	CX 3.7.4	SPA 307-04e	DDC Sensor Installation	40	L1	20:00 est	
119			COURSE CX 3.8: Control System Analysis - Air Handling & Hydronic Systems				
120	CX 3.8.1	SPA 308-01e	Analysis of Air Handling Systems	40	L1	20:00 est	

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5. Analysis Methodology
6. Analysis Methodology
7. Diagnostics
8. Diagnostics
9. Installation Related Issues
17. Programming Related Issues
23. Lesson Summary
24. Quiz

Diagnostics

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1

Typical Operator Settings to Check

- Discharge air temperature
- Duct static pressure
- Building static pressure
- Economizers
- Optimum start
- Warm up mode
- Minimum outside air
- Night low limit

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Diagnostics

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2

Other Features, Issues & Deeper Settings

- Hot gas bypass
- Low ambient kits
- Confirm ≥ 350 cfm/ton from balance report

03/20

1 2 3 4 5 6 7 8 9 10 11 12 13

Cisco AnyConnect VPN Client

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Commissioning Authority Training

- + Fundamentals of Commissioning
- + Commissioning Systems & Equipment
- Systems Performance & Analysis
 - + Design Review
 - Mechanical System Analysis - Air Distribution
 - > Analysis of Packages HVAC Equipment
 - Analysis of Air Moving Equipment
 - Analysis of Duct Design
 - Analysis of Space Airflow and General Exhaust
- TAKE THE ASSESSMENT
 - + Mechanical System Analysis - Hydronic Heating and Cooling
 - + Mechanical System Analysis - Tab

Analysis of Packages HVAC Equipment

This lesson details analysis of packaged HVAC equipment.

Lesson Learning Objectives:

- Explain packaged HVAC equipment analysis
- Diagnose typical installation-related deficiencies
- Identify common programming and set-up errors

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BCA Building Commissioning Association

To tap the highest level of subject matter expertise, Peci partnered with the Building Commissioning Association to develop the Commissioning Authority Training curriculum.

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