The State of the Commissioning Industry (with a focus on Critical Facilities)

Terry L. Rodgers, CPE, CPMP

VP Primary Integration Solutions, Inc.

Voting Member of SPC 90.4 Committee

704-942-1185

trodgers@primaryintegration.com

TERRY RODGERS, CPE,CPMP

Active member of:

- **ASHRAE TC 9.9** *Mission Critical Facilities, Technology Spaces, & Electronic Equipment*

- **ASHRAE SSPC-90.4** *Energy Standard for Data Centers & Telecommunications Buildings*

- **ASHRAE GPC-1.2** *The Commissioning Process for Existing Buildings*

- **ASHRAE SPC-127** *Method of Testing for Rating Computer Room & Data Processing Room Unitary Air Conditioners*

Terry is a Vice President with Primary Integration Solutions, Inc. and has over 35 years of progressive experience in Critical Facilities operations and management. Terry is a regular contributing writer for Mission Critical Magazine which publishes his bi-monthly column called *Sustainable Operations.* He has performed over 40 data center assessments in 20 countries and 5 continents over the last three years.

Primary Integration is an industry certified, independent 3rd party commissioning and facilities management consulting firm offering complete services from initial planning stages to design, through construction and ongoing operations of mission critical facilities.

➢ Some Personal Thoughts & Observations

➢ ASHRAE Guidelines Updates

➢ ASHRAE Standards Updates

➢ ASHRAE TC 9.9 Updates

➢ Commissioning Certifications Updates

➢ Training Updates

➢ Some Domestic Data Center Market Data

➢ Some Canadian Data Center Market Data

➢ Some International Observations

➢ More Info and Credits

➢ Q&A

Some Personal Thoughts and Observations

- Good News – The Commissioning Industry is Very Healthy!

  - Many entities are including commissioning as required for most if not all capital construction projects

  - Almost all critical facilities projects now include commissioning for all significant construction including upgrades, replacements, expansions, etc.

  - New commissioning standards and guidelines are being developed

    - specific to critical facilities

    - existing buildings and systems

    - development of "Systems Manuals"

  - More corporations/organizations/agencies are establishing corporate commissioning standards

  - Generally, most owners are becoming more knowledgeable about the value and benefits of formal commissioning

Some Personal Thoughts and Observations

- Bad News - (Way Too Many) Common Misunderstandings
    - Acceptance Testing vs Full Life-Cycle Commissioning
    - Engage the CxA as part of the Construction Phase
    - Factory Witness Testing (FWT) isn't necessary
    - Cx Discrepancy Logs vs "Punch Lists"
    - Facilities Staff should develop the Standard Operating Procedures (SOPs)
    - Block purchase of "training hours" from Vendors is sufficient
    - "Close-out" documentation are binders full of O&M manuals
    - Not enough attention to As-Built/Record drawings
    - Lots of commissioning certification organizations and types of certifications with varying focuses, eligibilities, training and experience requirements, recognitions, etc.

ASHRAE Guidelines Updates

- **Guideline 0-2013** *The Commissioning Process*
  - Standard is under "continuous maintenance" (1 of only 4 ASHRAE Guidelines under continuous maintenance)
  - Work is in progress to update/maintain the guideline

- **Guideline 0.2-2015** *Commissioning Process for Existing Systems and Assemblies*
  - Approaching 3-year anniversary – will be reviewed comprehensively for "further development"

- **Guideline 1.1-2007** *HVAC&R Technical Requirements for The Commissioning Process*
  - Work continues on keeping the document current and addressing comments, etc. (normal document maintenance)

ASHRAE Guidelines Updates

- Proposed **Guideline 1.2** *Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies*

    - Normative text finalized
    - Committee voting to submit for Publication Public Review (PPR)

- **Guideline 1.4-2014** *Procedures for Preparing Facilities Systems Manuals*

- **Guideline 1.5-2012** *The Commissioning Process for Smoke Control System*

- **Guideline 4-2008** (RA 2013) *Preparation of Operating and Maintenance Documentation for Building Systems*

    - Updated and republished in 2013

ASHRAE Guidelines Updates

- **Guideline 5-1994 (RA 2001)** *Commissioning Smoke Management Systems*

- **Guideline 11-2009** *Field Testing of HVAC Controls Components*

- **Guideline 14-2014** *Measurement of Energy and Demand Savings*

- **Proposed Guideline** *Commissioning of Data Centers*
  - Sponsored/championed by ASHRAE TC 7.9 *Building Commissioning*
  - Proposal sent to PPIS (Planning, Policy & Interpretations Subcommittee)

ASHRAE Standards Updates

- **Standard 90.1-2016** Energy Standard for Buildings Except Low-Rise Residential Buildings
  - Under continuous maintenance
  - Still includes data centers (conflict with Std 90.4)
  - Work ongoing to reconcile with Std 90.4

- **Standard 90.4-2016** Energy Standard for Data Centers
  - Approved as a Standard by ASHRAE BOD
  - Moved into continuous maintenance (SSPC 90.4)
    - Addendums A & B out for Public Review & comment
  - Recommended for adoption by the ICC BOD
  - Rejected by ICC in 1st ever electronic voting
  - SSPC 90.4 is actively working to promote to ICC
  - A subcommittee has been formed to add/embellish sections dealing with commissioning, system manuals, maintenance…

ASHRAE Standards Updates

- **Standard 127-2012** Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners
  - Committee voted to submit changes for Publication Public Review (PPR)
  - Title, Purpose and Scope revised
    - New Title: Method of Testing for Rating Air Conditioning Units Serving Data Center and Other ITE Spaces
    - Purpose is now focused on Method of Testing and defers to AHRI 1360 for testing conditions where existing
    - Scope increased to include RDHXs, Compressorless Pumped Refrigeration Systems, and other new cooling technologies
  - Works in conjunction with Std 90.4
    - Manufacturers who's products are rated compliant with this standard can use results to meet 90.4 efficiency requirements

ASHRAE Standards Updates

- **Standard 202-2013** Commissioning Process for Buildings and Systems
  - Originally published in 2013
  - Addendum A was published in July 2017
  - Only change was change CxA (Commissioning Authority) to be Cx Provider
  - Adopted by NIBS (National Institute of Bldg Sciences) Whole Bldg Design Guide (WBDG)
  - Not required by any bldg code (as far as I can tell)

ASHRAE TC9.9 Updates

ASHRAE Winter Conference: Chicago 1/20-24/2018

- Concurrent with AHR Expo

TC9.9 Committee Mtgs

- Sun 1/21 and Mon 1/22
- New committee chair: Jason Matteson (Lenovo)

TC9.9 Datacom Book Series & Publications - Updates

- ASHRAE Applications Handbook Chapter 19 *Data Centers and Telecommunication Facilities* has been updated
- DCIM Subcommittee whitepaper has evolved into a new book (over 100 pages long so far)
- Datacom Book 2 – *Datacom Equipment Power Trends and Cooling Applications* is in process of being updated for a new edition
- Datacom Book 3 – *Design Considerations for Datacom Equipment Centers* is in process of being updated for a new edition

ASHRAE TC9.9 Updates

TC9.9 Datacom Book Series

- 2016 – *IT Equipment Design Impact on Data Center Solutions*
- 2015 – *Thermal Guidelines for Data Processing Environments, 4th Ed.*
- 2015 – *Server Efficiency—Metrics for Computer Servers & Storage*
- 2015 – *Thermal Guidelines for Data Processing Environments, 4th Ed.*
- 2014 – *Data Center Design & Operation, 4th Ed.*
- 2013 – *Particulate & Gaseous Contamination in Data Environments, 2nd Ed.*
- 2013 – *Liquid Cooling Guidelines for Datacom Equipment Centers, 2nd Ed.*
- 2013 – *PUE: A Comprehensive Examination of the Metric*
- 2012 – *Datacom Equipment Power Trends & Cooling Applications, 2nd Ed.*
- 2010 – *Green Tips for Data Centers*
- 2009 – *Best Practices for Datacom Facility Energy Efficiency, 2nd Ed.*
- 2009 – *Structural & Vibration Guidelines for Datacom Equipment Centers*
- 2008 – *High Density Data Centers – Case Studies & Best Practices*

ASHRAE TC9.9 Updates

2015 – Thermal Guidelines for Data Processing Environments, 4th Ed.

Table B.1   2015 Thermal Guidelines—I-P Version (SI Version in Table 2.1)

	Equipment Environment Specifications for Air Cooling						
	Product Operation[b,c]					Product Power Off[c,d]	
Class [a]	Dry-Bulb Temperature[e,g], °F	Humidity Range, Noncondensing[h,i,k,l]	Maximum Dew Point,[k] °F	Maximum Elevation[e, i, m], ft	Maximum Rate of Change[f], °F/h	Dry-Bulb Temperature, °F	Relative Humidity,[k] %
Recommended (Suitable for all four classes; explore data center metrics in this book for conditions outside this range.)							
A1 to A4	64.4 to 80.6	−15.8°F DP to 59°F DP and 60% rh					
Allowable							
A1	59 to 89.6	−10.4°F DP and 8% rh to 62.6°F DP and 80% rh	62.6	10,000	9/36	41 to 113	8 to 80
A2	50 to 95	−10.4°F DP and 8% rh to 69.8°F DP and 80% rh	69.8	10,000	9/36	41 to 113	8 to 80
A3	41 to 104	−10.4°F DP and 8% rh to 75.2°F DP and 85% rh	75.2	10,000	9/36	41 to 113	8 to 80
A4	41 to 113	−10.4°F DP and 8% rh to 75.2°F DP and 90% rh	75.2	10,000	9/36	41 to 113	8 to 80
B	41 to 95	8% to 82.4°F DP and 80% rh	82.4	10,000	N/A	41 to 113	8 to 80
C	41 to 104	8% to 82.4°F DP and 80% rh	82.4	10,000	N/A	41 to 113	8 to 80

* For potentially greater energy savings, refer to the section "Detailed Flowchart for the Use and Application of the ASHRAE Data Center Classes" in Appendix C for the process needed to

ASHRAE TC9.9 Updates - Whitepapers

Thermal Management:

- *2016 Data Center Power Equipment Thermal Guidelines & Best Practices*

- *2013 Networking Thermal Guidelines*

- *2012 IT Equipment Thermal Management and Controls*

- *2008 Environmental Guidelines for Datacom Equipment – Extended Environmental Envelope*

- *Clarification to ASHRAE Thermal Guidelines*

Gaseous and Particulate Contamination:

- *2011 Gaseous & Particulate Contamination Guidelines for Data Centers*

- *2009 Contamination Guidelines for Data Centers*

ASHRAE Standard 90.1:

- *2011 Std 90.1-2010 Applicability to Datacom*

Data Center Storage Equipment:

- *Data Center Storage Equipment Whitepaper*

ASHRAE TC9.9 Updates - Whitepapers

Proposed Whitepapers:

- ITE Subcommittee is working on a whitepaper on Storage Devices

    - Including means to optimize terabytes/$$$

    - Discusses effect of acoustics (fan noise) on hard drive performance

- IT Equipment Water Cooling Design Guidelines & Best Practices (Liquid Cooling) whitepaper

    - Table of Contents and outline completed

    - The related work will lead to the update of Datacom Book 4 – *Liquid Cooling Guidelines for Datacom Equipment Centers*

ASHRAE TC9.9 Updates - Research

ASHRAE TC9.9 Sponsored Research

- Research Proj 1499 – ***The Effect of Humidity on Static Electricity Induced Reliability Issues of ICT Equipment in Data Centers***
  - University of Missouri, Completed and Published

- Research Proj 1675 – ***Guidance for CFD Modeling of Data Centers***
  - Florida International University (FIU), Scheduled for completion Feb. 2018
  - FIU has failed to start work on research, deliver a research plan, or a timeline. Contract may be canceled and re-bid
  - 1 year lost and may have to start over

- Research Proj 1755 – ***Impact of Gaseous Contamination & High Humidity on the Reliable Operation of IT Equipment in Data Centers***
  - Syracuse University, Scheduled for completion June 2018
  - Research is progressing well, literature review phase completed
  - Higher rates of corrosion being seen than anticipated

Certifications Updates

- **Commissioning Certifications**:
  - There are at least 7 Commissioning Certification Organizations
  - There are at least 19 different Commissioning Certifications
  - Some are for individuals, some are for firms
  - Some are mostly focused on HVAC and TAB
  - Some address building energy use
  - Some are focused on managing the commissioning process
  - Some are focused on the technical aspects of commissioning
  - Less attention to electrical power generation and distribution than HVAC and controls

Certifications Updates

- **1) Associated Air Balance Council** (AABC) **Commissioning Group** (ACG)
  - 1. Certified Commissioning Authority (CxA)
  - 2. Certified Commissioning Technician (CxT)

- **2) Association of Energy Engineers** (AEE)
  - 3. Certified Building Commissioning Professional (CBCP)
  - 4. Existing Building Commissioning Professional (ECBCP)
  - Recognized by the US DOE

- **3) ASHRAE**
  - 5. Commissioning Process Management Professional (CPMP)
  - Will become Bldg Commissioning Professional (BCxP) in 2018
  - Recognized by US DOE

Certifications Updates

- **4) Building Commissioning Association** (BCA)
  - 6. Associate Commissioning Professional (ACP)
  - 7. Certified Commissioning Professional (CCP)
  - 8. Certified Commissioning Firm (CCF)

- **5) National Environmental Balancing Bureau** (NEBB)
  - 9. Building System Commissioning (BSC)
  - 10. Retro-Commissioning (RCx)
  - Can certify individuals and/or firms

- **6) Testing Adjusting and Balancing Bureau** (TABB)
  - 11. Certified Commissioning Supervisor (CCS) - individuals
  - 12. Certified Commissioning Contractor (CCC) – firms

Certifications Updates

- **7) The University of Wisconsin-Madison**
    - 13. Accredited Qualified Commissioning Process Provider (QCP)
    - 14. Accredited Building Enclosure Commissioning Process Provider (BECxP)
    - 15. Accredited Commissioning Authority + Building Enclosure (CxA+BE)
    - 16. Accredited Commissioning Process Authority Professional (CAP)
    - 17. Accredited Commissioning Process Manager (CxM)
    - 18. Accredited Commissioning Process Technical Support Provider (CTS)
    - 19. Accredited Green Commissioning Process Provider (GCP)
- If I got all the individual certs:
    - Terry Rodgers, CxA, CxT, CBCP, ECBCP, CPMP, ACP, CCP, BSC, RCx, CCS, QCP, BECxP, CxA+BE, CAP, CxM, CTS, GCP

Training and Certifications Updates

- Eligibility Requirements for Commissioning Certifications:
    - Some require minimal levels of experience
    - Some vary the required experience based on the level of education
    - Some require client references
    - Some require both experience and client references
    - Some require neither

Training Updates

- Cx Certification Training:
  - Most certifications are associated with some related training program offered by the certification organization
  - Some provide training only on the commissioning process
  - Some provide training on both the commissioning process and the technical skills and knowledge
  - Several require completion of a training course prior to sitting for the certification exam:
    - ACG's CxT
    - AEE's CBCP
    - Univ of Wisc-Madison's certs (QCP, BECxP, CxA+BE, CAP, CxM, CTS, GCP)

Training Updates

BCxA University Certification program

- On-Demand Courses
  - Mod 1 – Fundamentals (2 courses, 17 lessons, 6 hrs)
  - Mod 2 – Cx Systems & Equipment (13 courses, 54 lessons, 19+ hrs)
  - Mod 3 – Sys.s Perf & Analysis (9 courses, 33 lessons, 12 hrs)
- In-Classroom Courses
  - BCxA New Construction Cx (2 days)
  - BCxA Existing Bldgs Cx (2 days)
  - Bldg Enclosure Cx (1 day)
- Webinars (1 hr training –earn AIA continuing edu credits)

BCxA's *The Building Commissioning Handbook, 3rd edition*

- 348 pages includes references, templates, examples, instructions

Training Updates

IDCA Data Center Training & Certifications

- IDCA = International Data Center Authority

  - DCIS – DC Infrastructure Specialist (2 day class + cert)

  - DCES – DC Engineering Specialist (3 day class)

  - DCOS – DC Operations Specialist (3 day class + cert)

  - DCTP – DC Technology Professional (3 day class + cert)

  - DCOM – DC Operations Manager (5 day class + cert)

  - DCIE – DC Infrastructure Expert (5 day class + cert)

  - DCE – DC Expert (8 day class + cert)

  - DCM – DC Manager (8 day class + cert)

  - DCA – DC Authority (11 day class + cert)

Training Updates

National Consortium for Mission Critical Operations (NCMCO)

- Developed with assistance of a $23M Federal Grant from Department of Labor

    - Certified Mission-Critical Professional (CMCP)

    - 2-Year degree programs in Mission Critical Operations

- NCMCO Industry Partners

    - ISA = International Society of Automation

    - Automation Federation

    - 7x24 Exchange – Carolinas Chapter

Training Updates

NCMCO - Continued

- NCMCO Academic Partners
  - Cleveland Community College – Implementation leader and recipient of approx. ½ the Fed Grant
  - Wake Tech Community College
  - Southern Regional Technical College
  - Nash Community College
  - UNC Charlotte – Not offering classes so far, but can integrate NCMCO classes into existing curriculums

Training Updates

NCMCO - Continued

- 1st year of full program started Sept 2017
  - Cleveland Community College
    - MCO – Operations Technology (AAS): 68 credit hrs (2 yrs)
    - MCO – Information Technology Diploma: 38 credit hrs (1 yr)
    - MCO – Operations Technology Diploma: 38 credit hrs (1 yr)
    - MCO – Info Technology Foundations Cert: 12 credit hrs
    - MCO – Ops Technology Foundations Cert: 12 credit hrs
  - Wake Tech
    - MCO AAS (Associate in Applied Science)
      - Intro to Mission Critical Ops Cert
      - Critical Electrical Systems Cert
      - Critical Control Systems Cert
      - Advanced Mission Critical Ops Cert

Training Updates

NCMCO - Continued

- Nash Community College
    - No NCMCO classes or information on website
- Southern Regional Technical College
    - No NCMCO classes or information on website
- UNC Charlotte (UNCC)
    - Working with NCMCO and above Community Colleges to develop MCO-AAS + transfer credits for BS at UNCC

Training Updates

Data Center Energy Practitioner (DCEP) Training

- US DOE Center of Expertise for Energy Efficiency in Data Centers

- Includes learning to use the Data Center Profiler (DC Pro) and select Assessment Tools

- Two DCEP Courses/Certifications:

  - DCEP Generalist – 1 day course + exam

  - DCEP HVAC Specialist – 2 day course + exam

- The Data Center Optimization Initiative (DCOI) was approved on 9/1/2016

  - Requires all Federal Agencies develop strategies to "transition to more efficient infrastructure"

  - Requires "all tiered data centers have at least one certified DCEP assigned to manage data center performance and continued optimization"

Some Domestic Data Center Market Data

- NoVA is leading the pack with Chicago in distant 2nd
- NorCal and Dallas/Ft Worth running 3rd & 4th
- Chicago is being driven by Cloud Providers
  - 23 MW leased in 1st half of 2017
  - 70% of this was leased by Cloud Providers
  - 44 MW is under construction with 17 MW already leased
- Northern VA is still hot (also Cloud driven), but not as much as in 2016
  - 55 MW leased in 1st half of 2016, 41 MW in 1st half of 2017 (-25.5%)
- Dallas/Ft Worth has finally lured in Cloud Providers
  - 18 MW leased in 1st half of 2016, 27 MW in 1st half of 2017 (+50%)
- Northern California is cooling off
  - 58 MW leased in 1st half of 2016, 3 MW in 1st half of 2017 (-94.8%)
- Atlanta is seeing real growth
  - 4 MW leased in 1st half of 2016, 8 MW in 1st half of 2017 (+100%)

Some Domestic Data Center Market Data

Top Data Center Markets	Total Inventory	Total Inventory	Available Capacity
Northern Virginia	12.6 Million SF	853 MW	91 MW of additional capacity
Chicago	3.8 Million SF	508 MW	30 MW of additional capacity
Dallas / Fort Worth	3.42 Million SF	458 Mw	56 MW of additional capacity
Northern California	4.6 Million SF	424 MW	23 MW of additional capacity
Pacific Northwest	3.9 Million SF	350 MW	54 MW of additional capacity
Northern New Jersey	3.1 Million SF	327 MW	30 MW of additional capacity
Los Angeles	2.3 Million SF	210 MW	18 MW of additional capacity
Atlanta	1.73 Million SF	207 MW	33 MW of additional Capacity
New York City	1.17 Million SF	164 MW	19 MW of additional capacity
Boston	1.2 Million SF	160 MW	16 MW of additional capacity
Las Vegas / Reno	2.1 Million SF	157 MW	56 MW of additional capacity
Phoenix	1.15 Million SF	145 MW	10 MW of additional capacity
Denver & Colorado Springs	750,000 SF	128 MW	28 MW of additional capacity
Houston	935,000 SF	120 MW	17.9 MW of additional capacity
Austin & San Antonio	526,000 SF	94.5 MW	9.7 MW of additional capacity

Some Canadian Data Center Market Data

- Montreal is leading the pack for Canada

  - 17.3 MW leased in 1st half of 2017

- Toronto is running close in second place

  - 13.9 MW leased in 1st half of 2017

- Western Canada is straggling but showing growth

  - 3.5 MW leased in 1st half of 2017

Some International Observations

- In many regions "independent, 3rd-party commissioning" is still not the norm

  - Many such regions still rely on the engineer-of-record (EOR) and general contractor (GC) to perform acceptance testing and other Cx activities

  - Some still have a "catch-me-if-you-can" approach where if the CxA doesn't catch the contractors cutting corners, then it's the CxA's fault

- The trend is moving toward the formal commissioning process

  - Many USA-based clients are requiring their international locations to use the same processes that they use in the US

  - Often these localities begin to embrace formal commissioning as they see the benefits, and it spreads as "Cx Firms" start getting formed.

  - Formal commissioning becomes a "differentiator" from their competition

More Info and Credits

- There is a lot of information available from BCA at www.bcxa.org

- The ASHRAE standards and guidelines can be found at www.ashrae.org

  - The info is available to anyone, but ASHRAE members get reduced rates

  - ASHRAE also has various training courses and certifications not mentioned in this presentation

- Some of the market data was derived from Jones Lang LaSalle (JLL) publication *Data Center Outlook, North America, H1 2017 – Shifting clouds, surging M&A*

- Good info found at the Univ of Wisc-Madison at https://epd.wisc.edu/app/uploads/2015/10/General_Information_Jan2017.pdf and associated links

- Some certification info was pulled from an article by Shaun May called *Making Sense of Commissioning Certifications*, 07/29/2015

The State of The Commissioning Industry (with a Focus on Critical Facilities)

QUESTIONS?

Terry L. Rodgers, CPMP, CPE
VP, Commissioning Services
Primary Integration
trodgers@primaryintegration.com
704-942-1185