Presenter Introductions

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Housekeeping

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Outline

- Commissioning Requirements
- What is Commissioning
- The Commissioning Process
- Case Study: Carl Hayden Visitor Center
- Case Study: Folsom Civil Maintenance Facility
- Results and Benefits
Federal Commissioning Requirements

• The Energy Independence and Security Act (EISA) of 2007 requires
  – Energy/water evaluations of 25% of “covered” facilities each year and/or 100% every 4 years
    • ID and assess re-or-retro-commissioning measures
• The Federal Guiding Principles require:
  – Commission new building construction
  – Retro-commission buildings greater than 50,000 sq ft every 4 years
  – Retro commission other buildings when not meeting energy performance requirements
  – Professional Commissioning Agent
BOR Commissioning Efforts

- Commissioning identified as a common recommendation in Reclamation
  - No existing building assessed in FY10-13 met sustainable building commissioning requirements
  - ID’d as an ECM in EISA evaluations
- Sought centralized funding and oversight
- Performed Commissioning on 22 Buildings
  - Prioritized based on Guiding Principle Target
  - Greatest need for energy reduction
- Conducted during FY 2014-2015
What Is Building Commissioning?

- Building Commissioning: Documented confirmation that a building’s various systems function according to criteria set forth in project documents AND owner’s operational needs.
- Not the same as Testing, Adjusting and Balancing. Commissioning diagnoses problems, provides corrective process and optimizes systems.
- Often identified as an ECM in an energy audit.
Commissioning for Optimal Efficiency

- **New Construction Commissioning**
  - Would you buy or drive a car that wasn’t tested?

- **Retro Commissioning**
  - Day-to-Day building maintenance is equivalent to only changing your oil
  - Performing major milestone checkups and maintenance (i.e., commissioning) increases efficiency, longevity and overall building health and helps avoid costly system repairs and breakdowns
What Does Commissioning Actually Look At?

• All water-and-energy consuming building systems:
  – HVAC
    • Thermal comfort
    • Indoor air quality
    • Acoustics
    • Zoning
    • Energy Consumption
  – Lighting Control
    • Sensor location
    • Scheduling
    • Light levels
What Does Commissioning Actually Look At?

• All water-and-energy consuming building systems:
  – Building Envelope
    • Seal integrity
  – Plumbing
    • Appropriate flow rates
    • Leakage
    • Hot water setpoint & scheduling
What Does Commissioning Not Do?

• Process procedures
  – Energy generation
  – Water diversion
  – Pumping operations

• Design & Oversee Install of New Major Equipment
  – Goal: Getting what is there working as efficiently and appropriately as possible
    • For example, making sure air handler is functioning, NOT air handler
  – Reports do often include recommendations where deemed necessary, but are only recommendations
  – Fixes made on-the-spot as feasible
The Retro Commissioning Process

- **Planning/Kickoff Phase**
  - Determine and document the needs and requirements for the facility
    - Review the original design documents
    - Determine if any building changes have been made
    - Interview Building Manager and key O&M personnel
    - Develop a Commissioning Plan that identifies the testing process as well as potential Energy Conservation Measures (ECMs).
The Retro Commissioning Process

• Investigation Phase
  – Execute testing processes from Commissioning Plan
  – Adjust Plan to meet any deviations observed in the actual building conditions and system performance
  – Revise initial ECMs as necessary and develop new ECMs based upon testing results
The Retro Commissioning Process

• Implementation Phase
  – Implement selected ECMs. Depending on complexity, this can be done by O&M personnel or a hired contractor
  – Verify that the predicted results and system performance are achieved
    • Onsite testing and evaluation required
The Retro Commissioning Process

- **Turnover Phase**
  - Hold a “Lesson’s Learned” meeting with O&M Staff and Building Manager
  - Issue a Commissioning Report that includes:
    - Building information
    - System descriptions
    - Commissioning Plan
    - List of implemented ECMs along with reasoning & expectations
    - Any long-term recommendations
    - Construction/As-Built documents, specs & submittals (existing/modified)
  - Ensures a smooth hand off between Commissioning Team and O&M personnel.
Case Study –
Carl Hayden Visitor’s Center

- Commissioned in August 2014
- Constructed in 1963
- 23,700 gsf
- Occupancy:
  - Office 6 am - 6 pm, M-F
  - Visitor Center 8 am - 6 pm, 7 days a week
Case Study – Carl Hayden Visitor’s Center

• HVAC
  – (5) Constant Volume air handling units with DX coils, and electric heat
  – Misc. exhaust and dedicated cooling (server room) systems

• Lighting Controls
  – Interior Lighting: Wall switches everywhere except occupancy sensors in the Admin area
  – Exterior Lighting: All controlled by a single photocell

• Plumbing
  – Various restrooms
  – Electric tank-style water heater supplemented by a solar heating system
Commissioning Findings

• The following systems were found to be in good working order and no modifications were made:
  – Lighting control
  – Plumbing
  – Solar water heater systems
Commissioning Findings

- The air handling unit economizers (allows the use of outside air to cool the building) were found to be manually overridden OFF.
  - All units were changed to be in the AUTO mode so they can utilize outside, cooler air when the program deems it advantageous.
  - Resulted in energy savings.
  - O&M staff were unaware that a manual override even existed and thought economizers were working based on DDC system.
Commissioning Findings

• The closing time of the Visitor’s Center had been changed from 8 PM to 6 PM, however the air handling units schedule was never changed to match.
  – The unoccupied schedule for the units were changed to match the 6 PM closing time.
  – This will save energy by reducing HVAC run time.
Commissioning Findings

• The unoccupied cooling setpoint for the units was found to be the same as the occupied setpoint (71 deg F). It was revised to be 5 deg F higher.
  – This will save energy by reducing HVAC run time.
Commissioning Findings

• The damper on the outside air intake was found to be closed. It was opened and balanced to meet the original design conditions (15%)
  – Measured CO2 levels in building prior to adjustment higher than recommended. Below 500 ppm after adjustment.
  – This will improve indoor air quality, which reduces employee sick days and improves production and morale.
Commissioning Findings

• Final Result:
  – 23% energy savings in FY 15!
  – Improved indoor air quality!
Case Study –
Folsom Civil Maintenance Facility

- Commissioned in March 2015
- Constructed in 2013
- 22,813 gsf
- Occupancy:
  - Office 6 am – 4:30 pm, M-F
  - Maintenance Areas: 6 am – 4:30 pm, M-F
Case Study –
Folsom Civil Maintenance Facility

• HVAC
  – Office: (5) Constant Volume heat pump air handling units
  – Shops: (4) Evaporative Cooling air handling units & heaters
  – Misc. exhaust

• Lighting Controls
  – Central Lighting Control panel with scheduling and astronomical capabilities, controls both office lighting and all exterior lighting
  – Shop lighting controlled by combo of occupancy sensors and wall switches

• Plumbing
  – Various restrooms, kitchen and shop sinks
  – Point of use water heaters
Commissioning Findings

- Plumbing system:
  - The laboratories were found to have 1.5 gallon/minute aerators, despite submittals indicating 0.5 gallon/minute
  - New 0.5 gal/min aerators installed to reduce water usage
Commissioning Findings

• Electrical System System:
  – Unplugged an abandoned refrigerated vending machine and had it slated for removal
  – Lighting control panel issues corrected
    • Majority of zones found to programmed and lighting was on 24/7
    • The few zones that were programmed operated on a 7 day, rather that a 5/2-day schedule as designed
    • Zones with large amount of daylight were scheduled to be turned off during peak solar hours.
      – Occupants have override switch that can be used if necessary
Commissioning Findings

- HVAC System:
  - Replaced all AHU filters as it was discovered they had never been changed
    - Varying parties all thought someone else was responsible
    - Improved Indoor air quality
    - Reduced airflow so much that one of the compressors failed due to it. Area was uncomfortably hot, but since a new building everyone thought it was just a poor design.
      - Will improve thermal comfort and save energy
Commissioning Findings

- HVAC System:
  - Office Thermostats were found to be unprogrammed
    - Scheduled setback for nights and weekends
    - Turned off continuous screen backlight
    - Added filter change reminders
    - Calibrated thermostats, found to be off 1-4 degrees F
    - Will both save energy and improve thermal comfort
Commissioning Findings

• HVAC System:
  – In two of the four shop areas, unit heaters and evaporative coolers found to have overlapping setpoints so both were operating at the same time.
    • Revised to appropriate setpoints and added temperature limit lockouts to prevent issue in the future
    • Will save a substantial amount of energy
Commissioning Findings

- HVAC System:
  - The ventilation fan in the Carpenter’s shop was found to have a blown fuse.
    - The fuse was replaced to provide the ventilation necessary to maintain indoor air quality
Commissioning Findings

• Final Result:
  – Energy savings (waiting on full year’s data for exact number)
  – Improved indoor air quality
  – Better thermal comfort
  – Reduced water consumption
Common Simple ECMs

• While there are many complex analyses and tests performed during Cx, many of the final ECMs are simple, easy to address items:
  – Adjust thermostat and lighting schedules to match occupancy
    • In many cases found unprogrammed and running 24/7
  – Open outside air damper
    • Often manually closed and never reopen.
    • No outside air = Sick Building Syndrome
Common Simple ECMs

• Replace dirty filters
  – Improves air flow, saving fan energy and delivering better thermal comfort

• Find non-functioning equipment
  • Often times bathroom fan had unknowingly failed
  • Heating valves stuck open and adjacent air conditioning running to compensate
Common Simple ECMs

- Leaky building openings
  - Replace/Install door and window weather stripping
  - Caulk roof and wall penetrations
- Seal duct, often installed with holes/leaks
- Bring economizers on line
  - Often overridden by O&M personnel
- Reposition lighting photocells
- Occupancy sensor adjustments
  - Many O&M employees don’t realize typically adjustable
Common Simple ECMs

- Never know what you are going to find, but there is always something that needs to be fixed
Commissioning Initiative Results:

- Identified and resolved building system operation, control and maintenance problems
- Improved indoor air quality and reduced associated liability
- Reduced occupant complaints and increased tenant satisfaction
- Lowered building energy usage and operational costs
  - In some buildings as much as 20%
- Documented system operations & trained O&M staff
- Extended equipment life-cycle
- Satisfied the Sustainable Building Assessment requirements
  - Helped 2 buildings achieve 100% compliance
  - Increased overall compliance rate by 10-20% across Reclamation
Questions?

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