Multnomah County

Facilities Specification Standards

Revised April 2014

MULTNOMAH COUNTY OREGON
Facilities and Property Management Division

TABLE OF CONTENTS

I. INTRODUCTION

Multnomah County Oregon (hereafter referred to as the County) establishes these standards to provide direction in the preparation of construction specifications for the County. This document identifies those standards that the County considers essential to preparing specifications and related documentation in a consistent and acceptable manner. These standards describe specification requirements for bid packages, format, content, editing, and quality.

General Objectives

The County issues these standards to:

1. Promote the successful use and control of project specifications and related documentation for Multnomah County owned buildings.
2. Establish minimum requirements for consistent format, professional appearance, and data interchangeability among specification files and other building documents.
3. Create accurate, accessible and current building and project documentation.
4. Expedite project delivery and reduce development cost.

Cross-References

Additional administrative requirements and related information may be found in:

1. *Multnomah County CAD Standards (Revised January 2012)*
2. *Multnomah County A/E Deliverable Standards (Revised January 2013)*
3. *Multnomah County Signage Standards (Revised January 2013)*
4. *Multnomah County Space Allocation Policy (Revised January 2013)*
5. *Multnomah County Strategic Facilities Plan (issued October 2012)*
6. *Healthy Purchasing Initiative (Resolution No 2012-150)*
7. *Toxic Reduction Strategy (Resolution No 06-073)*
8. *LEED Gold & High Performance Green Building Policy (Resolution No. 08-004)*
9. *Multnomah County Healthcare Design Guidelines (Issued May 2006)*
10. *National Electrical Installation Standards*

Changes from Previous Version

This version provides new information and changes some standards established in the previous issue. The standards incorporate the revisions in the Construction Specifications Institute (CSI) divisions.
Appendix A references updated Division 1 Templates. Appendix B adds Basis of Design information for fire-related material, door hardware, and flooring. Appendix C revises Basis of Design information for backflow devices, chiller controls, building control selections, and balancing firms. Appendix D and Appendix E added.

A/E Service Provider Responsibility

The County requires that all specifications submitted from the A/E Service Provider comply with these standards. An A/E Service Provider is defined as an organization contracted to provide professional services requiring planning and/or design work, and may include architects, engineers, consultants, drafting services, furniture installers, interior designers, space planners, or design-build contractors (who have professional liability insurance and the capability to produce digital documents).

For any deviation from these standards, submit a written request with specific explanations to the County Project Manager (hereafter referred to as the Project Manager). The Project Manager is the person designated to represent the County on issues for a specific project. The County will review the request and respond with a written authorization of acceptance or explanation of denial.

Comments or Questions

The County welcomes your recommendations to improve our documents and documentation process. Address comments or questions about the interpretation or use of these standards to:

Mike Di Blasi, Licensed Architect, LEED AP (503) 988-4044 mike.diblasi@multco.us

MULTNOMAH COUNTY OREGON
Facilities and Property Management Division
401 N. Dixon St.
Portland, OR 97227-1865

II. BID PACKAGES

Provide specification sections and information, which the County will assemble together with their documents and issue as Bid Packages to solicit work on public projects. For samples of County-provided documents and templates, refer to *Exhibit A1: Disk Directory*. For coordination with drawing documents, refer to the *Multnomah County CAD Standards*.

FORMAL BIDS (Greater or Equal to $150,000)

Bidding Pages for Construction

The County prepares separate Bidding Pages to provide information unique to each project. At contract signature, the Bidding Pages are attached to the Project Manual and Addenda to form the "Specification and Contract Agreement". Bidding Pages for Construction may include:

1. Invitation to Bid.
2. Table of Contents.
3. Instructions to Bidders.
4. Workforce Training & Hiring Program.
5. Bid Forms.
6. Bid Bond (form).
7. State of Oregon First Tier Subcontractor Disclosure Requirements.
8. Monthly Subcontractor Payment and Utilization Report (Form D).

Project Manual for Construction

The County assembles material from the County and A/E Service Provider into a Project Manual, organized as follows:

1. Title/Certification Page: A/E Service Providers (and their associated professional consultants) stamp and sign the Title/Certification page in accordance with state laws, professional practices, and their contract obligations. Refer to *Exhibit A2: Sample Title/Certification Page*.
2. Table of Contents: The County prepares a Table of Contents to list all specification division numbers and names, whether used or not. Where not used, the County will indicate "NOT USED" after the division number and name. The Table will also list specification section numbers and names used for each division and their page number.
3. Conditions of the Contract: The County prepares specification sections and exhibits for the Conditions of the Contract, which may include the following:
    a. Contract Agreement,
    b. General Conditions,
    c. Supplementary Conditions (where applicable), and
    d. Prevailing Wage Rates (where BOLI and/or Davis Bacon rates are applicable).
4. Technical Sections: A/E Service Providers have sole responsibility to prepare all technical specification sections (Division 1-49-). Edit standard specifications templates where provided by the County. Elsewhere use the standard MASTERSPEC® template or A/E Service Provider standard specifications to develop project-specific specification sections. Consider Basis of Design information found in *Appendix B, C, D and E.* Follow general principles found in the *CSI Manual of Practice*.

Addenda

The County may issue addenda during the bid process. Addenda form part of the Contract Documents and may modify previous Addenda, Bidding Pages, Project Manual and Drawings. The County lists items of addition, deletion, change, or clarification for those sections it is responsible. The County refers to and attaches the A/E Service Provider stamped list of items for those sections it is responsible for. Where a Pre-Bid Conference is mandatory, the County will issue the Attendance List in an addendum.

INFORMAL BIDS (Less than $150,000)

Project Manual

Where the County indicates the project does not require a Formal Bid, the County assembles material from the County and A/E Service Provider into a Project Manual organized as follows:

1. Invitation to Bid: The County prepares the solicitation forms.
2. Title/Certification Page: A/E Service Providers (and their associated professional consultants) stamp and sign the Title/Certification page in accordance with state laws, professional practices, and their contract obligations. Refer to *Exhibit A2: Sample Title/Certification Page*.
3. Table of Contents: The A/E Service Provider prepares a Table of Contents to list all specification division numbers and names, whether used or not. Where not used, the A/E Service Provider will indicate “NOT USED” after the division number and name. The Table will also list specification section numbers and names used for each division and their page number.
4. Instructions to Bidders: The County describes requirements for bidders and the bidding process.
5. Bid Forms: The County modifies standard bid forms for specific project requirements.
6. Conditions of the Contract: The County prepares specification sections and exhibits for the Conditions of the Contract, which may include the following:
    a. Contract Agreement (Public Improvement Contract), and
    b. Prevailing Wage Rates (if BOLI and/or Davis Bacon rates are applicable).
7. General Requirements: The County modifies standard specification templates to provide a single Exhibit A (in lieu of Division 1 sections). Where specific paragraphs are not used, the County will indicate “NOT USED” in the Table of Contents.
8. Technical Sections: A/E Service Providers have sole responsibility to prepare all sections of Division 1-49. Edit standard specifications templates where provided by the County. Elsewhere use the standard MASTERSPEC® template or A/E Service Provider standard specifications to develop project-specific specification sections elsewhere. Consider Basis of Design information found in *Appendix B, C, D and E*. Follow general principles found in the *CSI Manual of Practice*.

III. FORMAT

Prepare specification templates and project specifications using the Construction Specifications Institute (CSI) 49-division format. For further instructions, refer to the *CSI Manual of Practice*.

Specification Template Format
The County may request an A/E Service Provider to prepare or modify a County standard specification template using MASTERSPEC®. When this occurs, the A/E Service Provider shall obtain a license to use MASTERSPEC®, a product of the American Institute of Architects, published by Arcom. The A/E Service Provider shall export each relevant MASTERSPEC® section into a separate Microsoft Word ® document and edit the Microsoft Word ® file to suit County requirements. The A/E Service Provider shall edit the specification template in accordance with the format instructions described below.

Technical Section Format
For specification templates and project specifications, use the standard CSI three-part format and adhere to the following:

1. Center the section number and name in upper case (separated by a dash) on the first page of each specification section.
2. Do not carry a sentence over to the next page. Finish the sentence on the current page, or start it at the top of the following page. Select pagination for "Widows and Orphans."
3. Center "END OF SECTION" on the last page of each specification section, two lines below the bottom text of the section.

Technical Page Format
Refer to *Exhibit 3: Sample Paragraph* for examples of the following requirements:

1. Text Font Style: Arial
2. Text Color: Automatic (including header and footer)
3. Text Size: 11 point (except 10 point for header and footer)
4. Margins: 1" top, 1" bottom, 1" left, 1" right, 1" header, .5" Footer
5. Paragraph Spacing: Set to 0
6. Page Header:
   Multnomah County Oregon <Consultant Name>
   <Building Code – Building Name> <Document File Path Name>
   <Project Number – Project Name> <Consultant Project Number>
7. Page Footer:
   <Publication Date> <Section Number - Name> Page # of #
   <% Complete – Set Name>

Abbreviations, Acronyms and Terms
Adhere to the guidelines, standards, and examples found in the *CSI Manual of Practice*. Use terms defined by the County in the General Conditions and other County publications. Conform to the following:

1. Use "Architect" when referring Architect, Engineer, or A/E Services Provider;
2. Use "Owner" when referring to Multnomah County Oregon; and
3. Use "Project Manager" to refer to Owner representative.

Writing Style
Adhere to the following:

1. Do not use specifications sections or portions thereof directly from previous projects or master specifications that belong to other clients.
2. Do not repeat the general requirements of Division 1 in the technical sections (Divisions 2 through 49).

3. Do not use broad statement requirements, such as, “Electrical requirements shall comply with Division 26”. Instead, list the specific sections which establish the requirements for the subject specification.
4. Use multiples of 7 days to establish time requirements (e.g. “respond in 14 days”) so that timelines contain multiples not fractions of weeks. Note the General Conditions define each “day” to be a calendar day (not business day or working day).

IV. CONTENT

Create and edit individual sections so that the content, intent, and meaning of the specifications incorporate the following.

Standard Requirements
The County establishes the following standard requirements, which shall be incorporated into individual specification sections wherever related discussion occurs.

1. Warranty: Specify individual product warranties only where greater than the two-year warranty requirement established by the General Conditions for formal bids or Exhibit A for informal bids.
2. Extra Stock: Specify additional material or parts beyond that required for proper installation and operation, only where required by Code.
3. Recycled Content: Specify recycled content building products to reduce the need for virgin materials and to support product recycling markets where practical. Recycled content products may contain post-consumer or post-industrial recycled content, or a combination of both.
4. Limit PVC Material: Where practical, specify alternates to polyvinyl chloride products (e.g. ABS, HDPE, or recycled plastic).
5. Local Building Material: Where practical, specify locally extracted or manufactured building materials and products to reduce the environmental impact, time and cost of transportation, and to support the local and regional economy.
6. Fire-Related Material: Specify fire industry approved products for all fire-resistive assemblies (e.g. dampers, doors) including fire detection, annunciation and suppression.
7. Lists of Acceptable Products: Promote unlimited competition consistent with the type and quality of work, and to maximize the use of standard products and current models.
    a. Product lists with five or less items shall include “or approved substitution” (not “or equal”). The substitution phrase will invoke requirements of the Request for Substitution (rather than a judgment whether products are equivalent).
    b. Product lists greater than five do not need to include the substitution requirement.
    c. Product lists shall not exceed ten items and should represent the best choices available for the current project.
    d. Listed or referenced materials and products shall meet the requirements of the specification section and the current project.

Sole Source Exemptions
The Multnomah County Board of Commissioners has granted exemptions for a limited number of products, which shall be specified as sole source (i.e. no product alternates listed or accepted). These exemptions do not preclude the selection of different or additional products if it is determined to be in the best interest of the County.

1. Notifier, a company of Honeywell Inc.: Fire Alarm Control Panels (FACP).
    a. Resolution 96-135 (1996 08 08): EXEMPTION TO SPECIFY THE NOTIFIER BRAND NAME FOR PURCHASE OF FIRE ALARM EQUIPMENT AND COMPONENTS.
    b. Term: Perpetuity.
2. Siemens Building Technologies Inc.: Building Automation Systems (BAS).
    a. Agenda Placement Request (2011 6 16): APPROVING THE SOLE SOURCE PROCUREMENT PROCESS TO CONTRACT WITH SIEMENS BUILDING TECHNOLOGIES, INC. FOR THE PURCHASE OF BUILDING AUTOMATION CONTROLS.
    b. Term: Five year period ending 2016 6 30.
3. Schlage, a business of Ingersoll-Rand Company Ltd.: Pedestrian door locks.

a. Resolution 01-105 (2001 08 09): AUTHORIZING AN EXEMPTION TO SPECIFY SCHLAGE BRAND LOCKS FOR ALL NEWLY ACQUIRED COUNTY BUILDINGS.
b. Terms: Perpetuity.

Basis of Design
The A/E Service Provider shall use materials, products and systems preferred by the County as the basis-of-design or benchmark for acceptance, when specifying related items.

1. Access Control: Specify Kantech card reader systems as basis of design.
2. Wiring: Specify all electrical wires and cable, circuits and motor disconnects to be manufactured by ISO -9001:2008 certified firms.
3. Refer to *Appendix B – Architectural Basis of Design* for other items preferred by the County.
4. Refer to *Appendix C – Mechanical Basis of Design* for other items preferred by the County.
5. Refer to *Appendix D – Electrical Basis of Design* for other items preferred by the County.
6. Refer to *Appendix E – Building Control Basis of Design* for other items preferred by the County.

Delegated Design
The A/E Service Provider shall provide specifications for engineered designs (rather than "design/build" or "performance and design" specifications), except where the Project Manager provides written authorization or where delegated design is the most common practice (e.g. pre-engineered metal buildings, fire suppression systems). Where professional design services or certifications by a design professional are required of the Contractor, the A/E Service Provider shall provide specific performance and design criteria for those products and systems. Delegated design submittals shall comply with the following County standards, which the A/E Service Provider shall attach to their specifications.

1. Deliverable Standards: Submittals shall comply with Multnomah County A/E Deliverable Standards.
2. CAD Standards: Drawings shall comply with the Multnomah County CAD Standards.

V. EDITING

Where they exist, the County may issue standard or modified specification templates for each project. The A/E Service Provider shall use those templates as a starting point for authorized project work. Refer to *Multnomah County A/E Deliverable Standards*.

Specification Templates
The County will continue to develop, modify and update standard specification templates. If authorized to prepare or modify standard specification templates, the A/E Service Provider shall:

1. Use the MASTERSPEC® section or County specification template (where it exists) that most closely reflects the work to be described in specification form. Create or modify editorial instructions in the style established by MASTERSPEC®.
    a. Use blue font, hidden text to provide general background information to the project specification writer.
    b. Use bold text with "< … >" as delimiters to convey specific editorial instructions to the project specification writer (e.g. to insert or modify text).
    c. Use bold text with "[…]" as delimiters to identify standard choices for the project specification writer.
2. Use the Microsoft Word ® "Track Changes" function (including automatic red font and underlining) to provide a paper trail for proposed additions, deletions and other modifications. When the final draft (e.g. section template) is approved, accept all changes and disable the track changes function.
3. Edit the header as if the specification template was developed as a Project. Edit the footer to indicate "Specification Template" in lieu of "Set Name".

Project Specifications
For each individual project, the County will issue specification templates and previous project record documents (specifications) where appropriate to the A/E Service Provider. The A/E Service Provider shall:

1. Insert project-specific information in the header and footer, including the current status of the specifications (e.g. Design Development, Construction Documents, or Bid Set).
2. When using MASTERSPEC® documents:
    a. Read the background information in blue font, hidden text. The template locates these comments prior to the paragraph to which they apply. When the final draft is approved, enable the hidden text function so that the comments are not automatically printed.
    b. Read the directions in bold text with "< … >" as delimiters. The template locates these directions within the paragraph exactly where they apply. Replace the directions text and their associated directional delimiters with text as instructed by the directions.
    c. Read the choices listed in bold text with "[…]" as delimiters. The template locates these choices where they will be included in the paragraph. Select one of the choices and convert the selected text to regular font. Delete the choices not selected and their associated bracket delimiters.
3. Use the Microsoft Word ® Track Changes function (in strike-out mode) to provide a paper trail for <u>proposed</u> additions, deletions and other modifications. When the final draft (e.g. Permit Set, Bid Set, or Construction Set) is approved, accept all changes and disable the track changes function.

Project Modifications
During the course of each project, the A/E Service Provider shall use the following editorial directions to issue modifications (e.g. Addenda, Change Orders, Construction Change Directives, or Minor Changes to the Work) as follows:

1. Use Microsoft Word ® Track Changes (in strike-out mode) to provide a written document preserving knowledge of facts or events for authorized additions, deletions and other modifications. Update the footer to indicate the revision date and modification Set Name (e.g. Addendum #2).
2. For the next revision to the same specification section, accept the previous insertions and deletions prior to "tracking" new changes. Update the footer to indicate the new revision date and modification Set Name (e.g. Addendum #3).
3. Refer to *Exhibit A4: Sample Project Modifications*.

Project Record Documents

At project closeout where authorized in writing by the Project Manager, the A/E Service Provider shall collect previously issued modifications (i.e. Addenda and Change Orders) and Contractor mark-up documents (i.e. "as-builts") into one set of Project Record Documents as follows:

1. Incorporate "as built" information as new insertions, deletions, and other modifications.
2. Indicate products selected and installed or used with bold font (e.g. in product lists).
3. Where Requests for Substitutions granted, use both bold text and "Track Changes".
4. Refer to *Exhibit A5: Sample Project Record Specifications*.

VI. QUALITY

A/E Service Providers shall review and correct their documents prior to submittal to the County. Pay special attention to following, which lists the most frequent specification quality concerns.

1. Verify that the items in Related Sections exist for the current project.
2. Verify that all product lists end with “or approved substitution” (not “or equal”) unless provided a sole source exemption approved by the Multnomah County Board of Commissioners or the list contains more than five choices.
3. Verify that mechanical and electrical specification sections do not restate or contradict information in Division 1 – General Requirements (or Exhibit A).
4. Verify that edited specification sections read clearly and do not create conflicts internally or with other sections.
5. Advise the Project Manager where errors, omissions or discrepancies occur in any County-provided documents, templates, or other building information.
6. Check grammar and spelling in specification sections.

APPENDIX A: Samples and Templates

EXHIBIT A1: DISK DIRECTORY (template files on accompanying disk)

DISK DIRECTORY – Specification Templates

Title/Certification Page

Table of Contents

Bidding Pages for Construction

Conditions of the Contract

Division 1

Exhibit A: Division 1 substitution for small projects

Section 01 11 00 – Summary of Work
Section 01 14 00 – Work Restrictions
Section 01 29 00 – Payment Procedures
Section 01 31 00 – Project Management and Coordination
Section 01 33 00 – Submittal Procedures
Section 01 40 00 – Quality Requirements
Section 01 50 00 – Temporary Facilities and Controls

Section 01 60 00 – Product Requirements
Section 01 70 00– Execution Requirements
Section 01 73 29 – Cutting and Patching

Section 01 74 19 – Construction Waste Management
Section 01 77 00 – Closeout Procedures

EXHIBIT A2: SAMPLE TITLE/CERTIFICATION PAGE

Multnomah County Oregon
B119 – Justice Center
CP00000 – Remodel Jails

I.M. Architect

TITLE AND CERTIFICATION

PROJECT NO. _____

ARCHITECT:

<Name>
<Address> **<Seal/Signature>**

STRUCTURAL ENGINEER:

<Name>
<Address> **<Seal/Signature>**

MECHANICAL ENGINEER:

<Name>
<Address> **<Seal/Signature>**

ELECTRICAL ENGINEER:

<Name>
<Address> **<Seal/Signature>**

EXHIBIT A3: SAMPLE PARAGRAPH

1.1 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Content: The specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases:

1. In accordance with *CSI Manual of Practice*, skip a line between Articles (e.g. 1.1 and 1.2) and between Paragraphs (e.g. A. and B.). Also skip a line between subparagraphs of different indentation (e.g. a. or (1)). Do not skip lines between subparagraphs of same indentation.
2. Imperative mood and streamlined language are generally used in the Specifications.

a. Occasionally, the indicative or subjunctive mood may be used in the Section text for clarity to describe responsibilities to be fulfilled indirectly by Contractor or by others when so noted.

(1) The Words “shall,” “shall be,” or “shall comply with,” depending on the context, are implied where a colon (:) is used within a sentence or phrase.
(2) Refer to *CSI Manual of Practice* and exhibits included therein for further guidelines and examples.

EXHIBIT A4: SAMPLE PROJECT MODIFICATIONS

Multnomah County Oregon
B119 – Justice Center
CP00000 – Remodel Jails
I.M. Architect

1.1 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Content: The specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases:

1. In accordance with *CSI Manual of Practice*, skip a line between Articles (e.g. 1.1 and 1.2) and between Paragraphs (e.g. A. and B.). Also skip a line between subparagraphs of different indentation (e.g. a. or (1)). Do not skip lines between subparagraphs of same indentation.
2. Imperative mood and streamlined language are generally used in the Specifications.

a. Occasionally, the indicative or subjunctive mood may be used in the Section text for clarity to describe responsibilities to be fulfilled indirectly by Contractor or by others when so noted.

(1) The Words “shall,” “shall be,” or “shall comply with,” depending on the context, are implied where a colon (:) is used within a sentence or phrase.
(2) Refer to *CSI Manual of Practice* and exhibits included therein for further guidelines and examples.

B. Acceptable Manufacturers:

1. Carnes.
2. Krueger.
3. Metalaire, Inc.; Metal Industries Inc.
4. Nailor Industries of Texas Inc.
5. Price Industries.
6. Titus.

C. Configuration: Diverting-damper assembly inside unit casing with control components located inside a protective metal or plastic shroud.

EXHIBIT A5: SAMPLE PROJECT RECORD SPECIFICATIONS

Multnomah County Oregon
B119 – Justice Center
CP00000 – Remodel Jails

I.M. Architect

1.1 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Content: The specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases:

1. In accordance with *CSI Manual of Practice*, skip a line between Articles (e.g. 1.1 and 1.2) and between Paragraphs (e.g. A. and B.). Also skip a line between subparagraphs of different indentation (e.g. a. or (1)). Do not skip lines between subparagraphs of same indentation.
2. Imperative mood and streamlined language are generally used in the Specifications.

a. Occasionally, the indicative or subjunctive mood may be used in the Section text for clarity to describe responsibilities to be fulfilled indirectly by Contractor or by others when so noted.

(1) The Words “shall,” “shall be,” or “shall comply with,” depending on the context, are implied where a colon (:) is used within a sentence or phrase.
(2) Refer to *CSI Manual of Practice* and exhibits included therein for further guidelines and examples.

B. Acceptable Manufacturers:
1. Carnes
2. Krueger.
3. Metalaire, Inc.; Metal Industries Inc.
4. Nailor Industries of Texas Inc.
5. Price Industries.
6. Titus.

C. Configuration: Diverting-damper assembly inside unit casing with control components located inside a protective metal or plastic shroud.

APPENDIX B: Architectural Basis of Design

EXHIBIT B1: GENERAL DISCUSSION

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compound (VOC). Limit use of polyvinyl chloride (PVC) based materials.

A. Adhesives

1. ***Flooring Adhesives***
   Before specifying any flooring product, consult with manufacturers to determine the correct adhesive to use with their product and whether they have low VOC adhesives. The following guidelines provide VOC limits for adhesives.
   a. ***South Coast Air Quality Management District - South Coast Rule #1168*:**
      Use this rule as a guideline to reduce emissions of VOC from the application of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers. Refer to www.aqmd.gov.

Welding & Installation	VOC Limit (grams/Liter)
Indoor carpet adhesives	50
Carpet pad adhesives	50
Wood flooring adhesives	100
Rubber flooring adhesives	60
Subfloor adhesives	50
Ceramic Tile adhesives	65
Subfloor adhesive	50
VCT & asphalt tile adhesive	50
Drywall and panel adhesive	50
Cove base adhesive	50

2. ***Framing and Construction Adhesives***
   Specify the following product(s) as the basis of design.
   a. ***DAP Inc.***
      2400 Boston Street, Suite 200
      Baltimore, MD 21224
      (800) 543-3840
      www.dap.com
      Product: DAP 4000 Subfloor/Deck Adhesive

3. ***Cove Base Adhesives***
   Specify the following product(s) as the basis of design.
   a. ***DAP Inc.***
      2400 Boston Street, Suite 200
      Baltimore, MD 21224
      (800) 543-3840
      www.dap.com

Product: DAP ® Beats the Nail® Cove Base VOC-Compliant Construction Adhesive

b. ***AFM***
350 West Ash Street, Suite 700
San Diego, CA 92101
(619) 239-0321 - Factory direct
afmsafecoat.com
Product: AFM 3-in-1

c. ***Advanced Adhesive Technology Inc.***
207 E Emory Street
Dalton, GA 30721
(800) 228-4583
aatglue.com

Product: 432 Modified Acrylic Cove Base Adhesive

d. ***Mapei***
1501 Wall Street
Garland, TX 75041-4046
(800) 426-2734 (42-mapei)
mapei.com
Product: Ultrabond ECO 575
Attributes: A premium wall-base adhesive specifically designed to provide superior bond and impact resistance for rubber, vinyl and carpet wall base..

EXHIBIT B2: WOOD AND PLASTICS

GENERAL NARRATIVE

Specify wood products from sustainable forests certified by the Forest Stewardship Council (FSC). Certified forest products come from forests that have been independently audited and verified, as well managed to maintain the health of the total forest ecosystem.

A. Certified Wood Distributors

Consult the following certified wood distributors to establish a basis of design:

1. ***Collins Wood Companies***
   1618 SW First Avenue, Suite 500
   Portland, OR 97201-5706
   (800) 329-1219
   www.collinsco.com

2. ***Endura Hardwoods***
   1303 SE 6th Avenue
   Portland, OR 97214
   (503) 233-7090
   www.endurawood.com

3. ***Cascadia Forest Goods, LLC***
   38083 Wheeler Road
   Dexter, OR 97431
   (541) 485-4477
   www.cascadiaforestgoods.com

4. ***Healthy Forest, Healthy Communities Partnerships (HFHC)***
   813 SW Alder Street, Suite 500
   Portland, OR 97205
   (503) 221-6911
   www.sustainablenorthwest.org

5. ***Green Depot***
   819 SE Taylor Street
   Portland, OR 97214
   (503) 222-3881
   www.greendepot.com

6. ***The Rebuilding Center***
   3625 N. Mississippi Avenue
   Portland, OR 97227
   (503) 331-1877
   www.rebuildingcenter.org

7. ***Green Mountain Woodworks***
   225 Rogue River Parkway
   Talent, OR 97540
   (541) 535-5880

B. Cabinetry

For cabinet hinges, specify RPC five-knuckle overlay hinges as basis of design.

Specify recycled content building products to reduce the need for virgin materials and help keep the recycling market strong. Recycled-content products can contain post-consumer or post-industrial recycled content, or a combination of both. Select from the wide variety of recycled content building products below for a basis of design.

1. ***Neil Kelly***
   804 N Alberta Street
   Portland, OR 97217
   (503) 288-7461
   www.neilkelly.com

C. Fiberboard Millwork

At least 25% of the fiber in these products is from post-industrial recycled resources, while the balance is certified as recovered fiber, consistent with U.S. EPA recovered fiber definitions. These products are made without formaldehyde-containing additives, and were shown in lab testing to be free of formaldehyde down to a detection limit of 0.05 ppm.

1. ***SierraPine, Ltd.***
   1050 Melody Lane, Suite 160
   Roseville, CA 95678
   (800) 676-3339
   www.sierrapine.com
   Product: Medite II
   Attributes: Medite II is an interior grade, engineered wood based panel manufactured from softwood fibers combined with formaldehyde-free synthetic resins. It can be used as a replacement for sanded plywood and solid wood in non-structural interior applications including: woodworking, cabinets, paneling, and standing running trim. Medite II is not suitable for structural applications or where moisture may be present. Medite II is locally manufactured in Medford, OR.

D. Straw Panels

Straw is an agricultural waste product that remains after harvesting of grains and is gaining acceptance as a building material. Straw panels are formed under high temperature and pressure into 2” to 4” thick blocks that are wrapped in heavy weight kraft paper, similar to drywall. Straw particleboard is 20% lighter than wood particleboard and has excellent machinability. The finely shredded straw fibers are pressed into panels along with a formaldehyde-free MDI binder.

1. ***Agriboard Industries***
   1401 Enid Drive
   Vernon, TX 96384
   (866) 247-4267
   www.agriboard.com

E. Marmoleum and Artoleum

Natural Linoleum is durable, low maintenance flooring made of linseed oil, pine rosin, sawdust, cork dust, limestone, natural pigments, and a jute backing. Adhesives for linoleum installation differ from vinyl flooring adhesives; a smooth, dry surface is essential for proper installation. Linoleum can be used for desktop and conference table surfaces. Specify heat-welded seams and integral cove flooring up vertical surfaces. Support cove at horizontal and vertical junction with cove strip to eliminate cracking.

1. ***Forbo Industries, Inc.***
   Humbolt Industrial Park
   8 Maplewood Drive
   Humboldt Industrial Park
   Hazelton, PA 18202
   (800) 842-7839
   www.forboflooringNA.com

BASIS OF DESIGN: MARMOLEUM (all facility types)			
Manufacturer	**Style**	**Color**	**Recycled Content**
Forbo	Real	3123 Arabesque	46.5% Pre-Consumer
Forbo	Real	3222 Jade	46.5% Pre-Consumer
Forbo	Grey-dations	3234 Forest Ground	46.5% Pre-Consumer
Forbo	Fresco	3828 Blue Heaven	46.5% Pre-Consumer
Forbo	Fresco	3858 Barbados	46.5% Pre-Consumer
Forbo	Fresco	3861 Arabian Pearl	46.5% Pre-Consumer
Forbo	Fresco	3876 Camel	46.5% Pre-Consumer

EXHIBIT B3: THERMAL AND MOISTURE PROTECTION

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compounds (VOC).

A. Joint Sealers

Specify the following product(s) as the basis of design.

1. ***Mon-Eco Industries Inc.***
   5 Joanna Court
   East Brunswick, NJ 08816
   (800) 899-6326
   www.mon-ecoindustries.com
   Products: Various mastics, sealants and adhesives

2. *Sika Corporation*
   201 Polito Avenue
   Lyndhurst, NJ 07071
   (800) 933-7452
   Products: Sikaflex-1a

B. Skylight Sealants

Specify the following product(s) as the basis of design.

1. ***Dow Corning Corporation***
   Corporate Center
   P.O. Box 994
   Midland, MI 48686-0994
   (800) 248-2481
   www.dowcorning.com
   Brand: Dow Corning 791 - Silicone Perimeter Sealant
   Attributes: Field apply to seal erected building components in both new and remedial applications (VOC: 46-48 grams/Liter)

C. Firestop Sealant

Specify the following product(s) as the basis of design.

1. ***TREMCO***
   Tremco Sealant/Weatherproofing Division
   3735 Green Road
   Beachwood, Ohio 44122
   (800) 321-7906
   www.tremcosealants.com
   Product: TREMstop IA
   Attributes: Single component, water-based, intumescent acrylic firestop sealant (VOC: 55 grams/Liter)

D. Multiple-Component High Performance Polyurethane Sealant

Specify the following product(s) as the basis of design.

1. ***BASF Construction Chemical Company***
   889 Valley Park Drive
   Shakopee, MN 55379
   (800) 243-6739
   www.buildingsystems.basf.com
   Product: Sonneborn Sonolastic Sealant Systems NP-2
   Attributes: VOC: 80 grams/Liter less water

E. Adhesive Caulking

Specify the following product(s) as the basis of design.

1. ***The Sherwin-Williams Company***
   101 Prospect Avenue NW
   Cleveland, Ohio 44115
   (800) 474-3794
   www.sherwin-williams.com
   Product: 3006 All Purpose Adhesive Caulk (white)
   Attributes: VOC: 42 grams/Liter

2. ***DAP Inc***
   2400 Boston Street, Suite 200
   Baltimore, MD 21224
   (800) 543-3840
   www.dap.com
   Project: Dynaflex 230
   Attributes: (VOC less water: 49 grams/Liter)

3. ***Franklin International***
   2020 Bruck Street
   Columbus, Ohio 43207
   (800) 877-4583
   www.franklininternational.com
   Product: GREENchoice Weatherproof Subfloor Adhesive
   Attributes: (VOC: 27 g/l)

F. Interior Caulking

A non-toxic water-based elastic emulsion type caulking compound designed to replace oil caulk and putty for windows, cracks and general maintenance work. Use for caulking windows, sealing cracks, filling holes, door perimeters, walls and woodwork, air duct openings, venting and plumbing areas, siding openings and masonry cracks. Does not dry out or crack and does not release any solvents or obnoxious odors.

1. ***DAP Inc***
   2400 Boston Street, Suite 200
   Baltimore, MD 21224
   (800) 543-3840
   www.dap.com
   Product: Alex Plus Acrylic Latex Caulk Plus Silicone

2. ***Liquid Nails***

15885 West Sprague Road
Strongsville, OH 44136
(800) 634-0015
www.liquidnails.com
Brand: LC-130 Super Caulk Window & Door

3. ***GE***
   9930 Kincey Avenue
   Huntersville, NC 28078
   (877) 943-7325
   www.siliconeforbuilding.com
   Product: SCS1000 Contractors

G. Expansion Joint Sealer

Specify the following product(s) as the basis of design.

1. ***Flex Bon Paints***
   2131 Andrea Lane
   Fort Meyers, FL 33912
   (239) 489-2332
   www.flexbon.com

   Product: Flex-Bon Pinnacle Acrylic Urethane Elastomeric Sealant.
   Attributes: Low-odor paintable sealant that performs similarly to one-part urethane sealants, such as at expansion and control joints (Low VOC 42 grams/Liter)

EXHIBIT B4: DOORS AND WINDOWS

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify oversized doors (42-inch or 48-inch wide) where carts, gurneys or materials are moved through the doorway. Glass panels in doors should not be located in the middle of the door adjacent to the lockset or middle hinge.

A. Wood Doors

Specify wood products from sustainable forests certified by the Forest Stewardship Council (FSC). Certified forest products come from forests that have been independently audited and verified, as well managed to maintain the health of the total forest ecosystem. Consult the Forest Stewardship Council at www.fsc.org to find FSC certified companies and their products.

1. ***Marshfield Door Systems***
   1401 East Fourth Street
   Marshfield, WI 54449
   (800) 869-3667
   www.marshfielddoors.com
   Products: Interior tenant doors
   Attributes: This company carries wood doors that are FSC-Certified.

B. Door Hardware

Match existing building standards and applications where practical to maintain uniformity. Where there are no building-specific standards in place or there will be significant changes throughout the building, use the following as basis of design: (1) maintain building uniformity; (2) specify 626 finish for door hardware; (3) use NL as basis of design wherever appropriate; (4) coordinate with electrical to provide plastic junction boxes for low voltage work such as card readers; and (5) specify construction cylinders to match building and keying systems so the County Locksmith may furnish and install final cylinders and keys; (6) Match lever and hardware designs for lever and exit devices; (7) Match building keyway with Primus cylinder

1. ***Exit Device:*** Use Von Duprin 99NL or 33NL where practical (but not 22NL) as basis of design. Where a card reader is indicated, coordinate with County Alarms to use Von Duprin with RX switches (or LX if approved by County) as basis of design. If Von Duprin power supplies are required for type of hardware, order power supply with keyed lock-keyed alike to match County Standards
2. ***Power Assistance:*** Where power-assisted door operation is indicated, use LCN 4600 series (electro hydraulic) or LCN 4800 series (pneumatic) where practical, as basis of design for the auto-actuator. Do not specify a vertical “contact bar” style actuator.
3. ***Latch:*** Use Schlage SPA or RHO (Rhodes) depending on existing hardware used in building as basis of design. For single unisex restroom, use occupancy indicator latch that is handicapped acceptable. Latches to be 2 3/4” backset or match existing building hardware.
4. ***Lock:*** Use Schlage only. (Refer to sole source exemptions.)
   a. Exterior: Where a card reader is indicated for the building exterior, use Ingersoll Rand/Schlage ND80PDEU or EL with Primus cylinders. Otherwise, use Schlage ND80PD with Primus cylinders. Do not use “Everest” cylinders.
   b. Interior: Where a card reader is indicated for the building interior use Schlage levers with store room function; use Von Duprin exit devices for storeroom functions (always locked when secured) and an LCN Door Closer. Card reader doors using Von Duprin exit devices will use store room function trim. Where a card reader is

indicated for building interior, use Ingersoll Rand/Schlage ND80PDEU or EL with cylinders that match the existing building master key system if the building is using electric levers.

c. Restroom: Provide ADA-compliant "occupied" indicator for single user unisex restrooms. Use Schlage B571 with occupancy indicator or Schlage L9496 Mortise with occupancy indicator to match building hardware.
d. Cylinder Core: Provide all locksets with temporary construction cores.
   (1) Keyway C: Use "C-1 Bitted" interior or Primus exterior typical.
   (2) Keyway E: Use "E-1 Bitted" for building mechanical spaces.
   (3) Keyway P: Use "P-1 Bitted" for elevator equipment room spaces.

5. If cylinders are not construction keyed, provide Multnomah county lock shop with all keys for hardware and cylinders. Multnomah County Lock Shop does all keying unless factory-keyed.
6. ***Electric Strike:*** Use Von Duprin 6211FSE-DS 24VDC as basis of design. Use the correct model of Electric Strike that is compatible with the hardware on the door.
   a. Electrically Locked: Verify whether to specify fail-safe EL.
   b. Electrically Unlocked: Verify whether to specify fail-safe EU.
7. ***Card Reader:*** Provided by County Alarms unless specified otherwise. Interior card reader: Use store room lever or exit devices with door closer. ***Closer:*** Use LCN 4040 as basis of design (not handed), except use LCN 4011 where 180 degree swing indicated. Where wall stops are not feasible, use closer to limit door swing. Do not place hold-open devices on fire/smoke doors (use magnetic holder).
   a. Unisex Restroom: Provide delay-action closer.
   b. Card Reader Door: Provide closer (with optional hold open EDA).
   c. Fire/Smoke Doors: Provide closer.
   d. Otherwise: Do not provide closer, unless required for acoustics or security.
8. ***Closer:*** Use LCN 4040XP as basis of design (not handed), except use LCN 4011 where 180 degree swing indicated. Where wall stops are not feasible, use closer to limit door swing. Do not place hold-open devices on fire/smoke doors (use magnetic holder).
   a. Unisex Restroom: Provide delay-action closer.
   b. Card Reader Door: Provide closer (with optional hold open EDA).
   c. Fire/Smoke Doors: Provide closer.
   d. Otherwise: Do not provide closer, unless required for acoustics or security.
9. ***Stop:*** Use wall stops (WS) where practical. Do not use floor stops, because they are trip hazards. Limit use of hinge stops, because they rack heavily-used doors.
10. ***Threshold:*** No specific requirements.
    a. Door Bottom: Coordinate with gasketing or weatherstripping. Use Pemko door bottom as basis of design.
    b. Gasketing: Provide where required to control fire, smoke, fumes, particulates, or sound.
    c. Silencer: Use gasketing or weatherstripping instead, because silencers don't last 30 years.
    d. Weatherstrip: Provide where exposed to weather or separating dissimilar micro-climates.
11. ***Plates:*** Provide at all exterior doors.
    a. Armor Plate: Provide half-door kickplates, where door used for cart, gurney or material movement.
    b. Kickplate: Provide at all exterior and stair doors.
12. ***Frames:*** ANSI Prep Only.

EXHIBIT B5: WALL SYSTEMS

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compounds (VOC).

A. Interior Steel Studs

Steel usually contains a minimum of 25% post-consumer recycled content. Such material comes from galvanized steel coils made up from a minimum of 25% recycled steel, using the Basic Oxygen Furnace process. Specify the following product(s) as the basis of design.

1. **Steeler™, Inc.**
   10023 Martin Luther King Jr. Way South
   Seattle, WA 98178
   (800) 275-2279
   www.steeler.com
   Attributes: Steel studs are locally manufactured in Seattle, WA.

B. Gypsum Board

Mining raw materials, gypsum, limestone, clay, talc, mica, and perlite) produces spoil erosion, pollutant runoff, and habitat loss. Gypsum is nonrenewable, although relatively abundant resource. Most gypsum board products are manufactured with paper backing from primarily recycled paper and gypsum core containing minimum 10 percent recycled gypsum. Percentages vary depending on the manufacturing facility, and are generally increasing throughout the industry as manufacturing facilities upgrade.

Gypsum has a non-combustible, dimensionally stable, gypsum core. The surfacing on both faces and on the long edges is 100% recycled paper. The front face and the long edges are an ivory color: the back face paper is gray. The ends are square cut, smooth finished with no paper facing. 100% of the facing paper used to make wallboard is recovered fiber. Approximately 5% is from post-consumer sources. Total recycled content is 13.96%. Post-industrial recycled content is 8.26%. Post-consumer recycled content is 5.70%. The recycled content in the core includes internal recycling, construction scrap, and synthetic gypsum. USGBC has determined that synthetic gypsum is post-industrial content. Specify the following product(s) as the basis of design.

1. ***Georgia Pacific Building Products***
   133 Peachtree Street NE
   Atlanta, GA 30303
   (800) 225-6119
   www.gp.com
   Product: Tough Rock ™ Light and Strong
   Attributes: The local Tacoma Washington plant will use synthetic gypsum and recycle paper. Synthetic or flu-gas gypsum is a waste product obtained from stack scrubbers for removing sulfur from coal-fired power plant emissions.

C. Pre-Finished Panels

Manufacturers use corrugated boxes and newspapers as the raw materials for some building panel products, using post-consumer and post-industrial waste fibers. Specify the following product(s) as the basis of design.

1. ***Homasote, Inc.***
   Lower Ferry Road
   P.O. Box 7240
   West Trenton, NJ 08628-0240
   (800) 257-9491
   www.homasote.com
   Products: Designwall, Nova Cork, and Burlap Panels

2. ***National Shelter Products, Inc.***
   50 SE Bush Street
   Issaquah, WA 98027
   (800) 552-7775
   www.nationalshelter.com
   Products: Unicor

3. ***SierraPine Ltd.***
   1050 Melody Lane, Suite 160
   Roseville, CA 95678
   (800) 676-3339
   www.sierrapine.com
   Products: Medex, Medite II, and MediteFR MDF

EXHIBIT B6: CERAMIC TILE

GENERAL NARRATIVE

Specify recycled content building products to reduce the need for virgin materials and keep the recycling market strong. Recycled content products can contain post-consumer or post-industrial recycled content, or a combination of both. Specify 5% overage on ceramic tile.

A. Tile Setting Materials and Accessories

Specify the following product(s) as the basis of design.

1. ***American Formulating & Manufacturing***
   3251 3rd Ave.
   San Diego, CA 92103
   (800) 239-0321
   www.afmsafecoat.com
   Product: AFM Safecoat 3 in 1 Adhesive
   Attributes: Water based adhesive with low VOC content

2. ***Laticrete International, Inc.***
   1 Laticrete Park North Bethany, CT 06524
   (800) 243-4788
   www.laticrete.com
   Products: Laticrete 4-XLT, 252, 253, 253R and 317

B. Ceramic Tile

Most manufacturers reclaim their fired scrap materials. Tile containing recycled glass is available. Recycled glass can contain pre-consumer and post-consumer industry waste such as windshield glass and waste from light bulb manufacture. Tile is an inherently low-toxic, durable finish material for flooring, walls, and other applications. Specify the following product(s) as the basis of design.

1. ***Bedrock Industries***
   1401 W. Garfield
   Seattle, WA 98119
   (206) 283-7625
   www.bedrockindustries.com
   Produts: Blazestone
   Attributes: Blazestone® tiles are made from 100% recycled glass.

2. ***Terra-Green Ceramic Tiles***
   1650 Progress Drive
   Richmond, IL 47374
   (765) 935-4760
   www.terragreenceramics.com
   Products: Terra Green Ceramic Tile
   Attributes: Terra Green Ceramic Tiles are made with 58% recycled aviation glass.

3. ***Summitville Tiles***
   State Highway 644
   Summitville, OH 43962
   (330) 223-1511
   www.summitville.com
   Attributes: Summetville porcelain and quarry tile products use feldspar tailings, a post-industrial waste product, as the primary raw material in a nearly solid-waste-free manufacturing process.

4. ***Crossville Ceramics Company***
   P.O. Box 1168
   Crossville, TN 38557
   (931) 484-2110
   www.crossvilleinc.com

EXHIBIT B7: CEILING SYSTEMS

GENERAL NARRATIVE

The major constituents of acoustical ceiling tiles are mineral wool (fabricated from slag and rock, cellulose, starch (primarily from corn), clay (for fire-rated products), fiberglass and paint. Mining raw materials produces soil erosion, pollutant runoff, and habitat loss. Manufacture of acoustic ceiling tiles does not generate much waste because scrap material is recycled back into the process.

A. Suspended Ceiling Systems

Specify the following product(s) as the basis of design.

1. ***Armstrong World Industries, Commercial Ceilings***
   P.O. Box 3001
   Lancaster, PA 17604
   (888) 234-5464

   www.armstrong.com
   Products: Mineral Fiber, Fiberglass and Bioacoustic
   Grid: Armstrong 15/16th White T-Bar Grid (not thin line)
   Tile: Cortega Second Look - Armstrong 703B - 2x2 or 2x4 only
   Attributes: Armstrong Ceilings Reclamation Program will take back used ceiling tiles and remanufacture them into new tiles

EXHIBIT B8: FLOORING SYSTEMS

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compounds (VOC). Specify 10% overage on flooring products.

A. Reclaimed Wood Flooring

Reclaimed wood flooring is typically salvaged from buildings that are typically 70 to 200 years old. Specify the following product(s) as the basis of design.

1. ***Collins Companies***
   1618 SW 1st Avenue, Suite 500
   Portland, OR 97201-5706
   (503) 471-2295
   (800) 329-1219
   www.collinsco.com
   Products: Certified wood, reclaimed wood, wood framing, wood stairs and railings

2. ***The Rebuilding Center***
   3625 N. Mississippi Avenue
   Portland, OR 97227
   (503) 331-1877
   www.rebuildingcenter.org

3. ***Resource Woodworks, Inc.***
   627 E 60th
   Tacoma, WA 98404
   (253) 474-3757

B. Bamboo Flooring

Despite the long transportation distance from China to the United States, bamboo is still considered a sustainable product because of its durability, hardness, and short regeneration time. Using materials that are considered rapidly renewable helps reduce the use of products that are considered long-cycle renewable materials. Rapidly renewable materials are typically planted and harvested in cycles of 10 years or less. These products tend to be more environmentally and economically friendly, use fewer natural resources, and require less labor to produce than other products.

1. ***Bamboo Flooring International***
   311, New Universe, Yi Jin Road
   Lin'an City, Hangzhou, Zhejiang, China0086-1370-6713111
   www.bamboo-flooring.com

2. ***Smith & Fong Company, Plyboo Bamboo Products***
   475 Sixth Street
   San Francisco, CA 94080
   (866) 835-9859
   www.plyboo.com

3. ***Bamboo Hardwoods Flooring, Inc.***

4100 Fourth Avenue, South
Seattle, WA 98134
(800) 607-2414
www.bamboohardwoods.com
Attributes: Bamboo hardwoods come from Vietnam. Sell both pre-finished and unfinished products.

C. Cork Flooring

Cork is a natural product that is obtained from the outer bark of the cork oak tree. Because the cork naturally regenerates in about 10 years, it can be harvested sustainable without killing the tree. Some cork flooring is fabricated from bottle-cork industry waste. Manufacturing process involves few toxins and generates very little waste because nearly all-manufacturing waste is recycled back into product.

1. ***Dodge Cork Company***
   119 South Tree Drive
   Lancaster, PA 17604
   (877) 326-7655
   www.dodgecork.com
   Product: Dodge Cork Tiles™
   Attributes: Available in various shades and finishes.

2. ***Duro-Design Cork Flooring***
   4656 Louis B. Mayer Street
   Laval, QC H7P 6E4 Canada
   (888) 528-8518
   www.duro-design.com
   iAttributes: Parquet tile floor made of 100% high-density cork

3. ***Gerbert Limited***
   119 South Tree Drive
   P.O. Box 4944
   Lancaster, PA 17604-4944
   (800) 828-9461
   www.gerbertltd.com

4. ***Expanko, Inc***
   180 Gordon Drive, Suite 113
   Exton, PA 19341
   (800) 345-6202
   www.expanko.com

5. ***USFloors***
   3368 Carpet Capital Drive SWDalton, GA 30720
   (800) 404-2675
   www.usfloorsllc.com

6. ***Linoleum City***
   4849 Santa Monica Blvd.
   Hollywood, CA 90029
   (800) 559-2489
   www.linoleumcity.com

7. ***Wicanders Cork***
   Rua do Ribeirnho No. 202
   Apartado 13
   4536-907 S. Paio Oleiros
   Portugal
   www.wicanders.com
   Brand: Corkcomfort Floating
   Attributes: Glueless cork system

D. Resilient Flooring and Adhesives

Specify materials that are considered rapidly renewable to help reduce the use of products that are considered long-cycle renewable materials. Rapidly renewable materials are typically planted and harvested in cycles of 10 years or less. These products tend to be more environmentally and economically friendly, use fewer natural resources, and require less labor to produce than other products. Specify slip-resistant textured flooring for stair landings and detectable warning tile on treads. Specify integral slip-resistant strip (1-inch minimum, full tread width) at each tread and landing edge, with a high-contrast color distinction (e.g. yellow non-skid strip on black treads).

1. ***Flooring Underlayment***
   Specify the following product(s) as the basis of design.
   a. ***Amorim Cork Composites***
      26112 110th Street
      Trevor, WI 53179
      (800)558-3206
      www.acousticorkusa.com
      Product: AcoutiCORK

   b. ***Dodge Cork Company***
      119 South Tree Drive
      Lancaster, PA 17604
      (877) 326-7655
      www.dodgecork.com
      Product: Cork Underlayment
      Attributes: Reduces the transmission of sound

   c. ***Homasote, Inc.***
      Lower Ferry Road
      P.O. Box 7240
      West Trenton, NJ 08628-0240
      (800) 257-9491
      www.homasote.com
      Product: Homasote 440 Sound Barrier, 440 Carpetboard and Comfort base
      Attributes: Homasote products are made from high-density fiberboard panels made from 100% recycled wastepaper and a formaldehyde-free paraffin binder.

   d. ***USFloors***
      3368 Carpet Capital Drive SWDalton, GA 30720
      (800) 404-2675
      www.usfloorsllc.com
      Product: Cork underlayment

2. ***Vinyl Flooring***
   Resilient flooring manufactured from 100% recycled PVC is available in sheet, tile, and plank products.
   a. ***Amtico International***
      66 Perimeter Center East, Suite 700
      Atlanta, GA 30346
      (800) 268-4260
      america.amtico.com
      Product: Stratica
      Attributes: Stratica is a chorine free, low-VOC, durable alternative to vinyl or VCT flooring

   b. ***Mohawk Group***
      706 Green Valley Road, Suite 300
      Greensboro, NC 27408
      (800) 331-0460
      www.themohawkgroup.com
      www.themohawkgroup.com
      Product: Stonewalk
      Attributes: . StoneWalk contains no PVC (polyvinyl chloride), halogens, or plasticizers and emits no VOC's into the environment

3. ***Slip-Resistant Flooring***
   Slip-resistant flooring is necessary for public or industrial entryways, work areas and high traffic areas, particularly where exposure to water may occur. Walk-off mats are also good sources of soil removal from foot traffic entering a building. See item D (Resilient Flooring and Adhesives) for slip-resistant flooring at stairs and landings.
   a. ***Flexco Corporation***
      1401 East 6th Street
      P.O. Box 553
      Tuscumbia, AL 35674
      (800) 633-3151
      www.flexcofloors.com
      Product: FlexTuft Rubber Tile®
      Attributes: FlexTuft® is a product with approximately 90% of the components comprised of recycled bus and truck tires

   b. ***U.S. Rubber Recycling, Inc.***
      1231 South Lincoln Street
      Colton, CA 92324
      (888) 473-8453
      www.usrubber.com
      Brand: SureStep Traffic Tire Tiles
      Attributes: SureStep™ Traffic Tires are made of recycled truck and bus tire linings

4. **Rubber Flooring**
   In the United States each year approximately 200 million tires are discarded; most enter landfills. Recycled-tire rubber provides a highly durable, resilient, slip-resistant Rubber floors may contain industrial and natural rubber. Industrial rubber is obtained through the polymerization of petroleum products. Natural rubber is a renewable raw material extracted from the sap of tropical rubber plants (without harming the plant). Rubber flooring is available with 75% to 100% post-consumer recycled content.

a. ***EcoStar LLC***
42 Edgewood Drive
Holland, NY 14080
(800) 211-7170
www.ecostarllc.com
Brand: Nova Walkway Pads
Attributes: EcoStar produces Nova Walkway Pads from a proprietary polymer made from 100% recycled post-industrial rubber and plastic

b. ***Surface America***
P.O. Box 157
Williamsville, NY 14231
(800) 999-0555
www.surfaceamerica.com
Attributes: Recycled tires and gym shoes used in flooring materials

c. ***U.S. Rubber Recycling, Inc.***
1231 South Lincoln Street
Colton, CA 92324
(888) 473-8453

www.usrubber.com

d. ***nora systems, Inc.***
9 Northeastern Blvd.
Salem, NH 03079
(800) 332-6672
www.nora.com

e. ***Ecore International***
715 Fountain Ave
Lancaster, PA 17601
(800) 322-1923
www.ecoreintl.com
Brand: ECOsurfaces
Attributes: Recycled rubber flooring

E. Linoleum Flooring

Linoleum is manufactured from cork, linseed oil, wood fiber, and pine resin. Ground-up stone and wood are added for color. The manufacturing process generates little waste because nearly all-manufacturing waste is recycled back into product. Natural Linoleum is durable, low maintenance flooring made of linseed oil, pine rosin, sawdust, cork dust, limestone, natural pigments, and a jute backing. Adhesives for linoleum installation differ from vinyl flooring adhesives; a smooth, dry surface is essential for proper installation. Linoleum can be used for desktop and conference table surfaces. For floor installations, specify heat-welded seams and integral cove flooring up vertical surfaces. Support cove at horizontal and vertical junction with cove strip to eliminate cracking.

1. ***Armstrong World Industries, Commercial Floors***

P.O. Box 3001
Lancaster, PA 17604
(888) 234-5464
www.armstrong.com
Products: Linoleum
Attributes: Linoleum is made from renewable raw materials

2. ***Forbo Industries, Inc.***
Humbolt Industrial Park
Maplewood Drive
P.O. Box 667
Hazelton, PA 182011
(800) 842-7839
www.forboflooringNA.com
Products: Marmoleum Composition Tile (MCT)
Attributes: Marmoleum pre-consumer recycled content is 46.5%.

EXHIBIT B9: CARPET

GENERAL NARRATIVE

Whenever feasible, carpet tiles, as opposed to broadloom should be used. When using carpet tile, and stairs are present, use rubber or vinyl stair treads and risers.

All carpet design layout of broadloom carpet should minimize the number of seams. Accent colors and patterns should be limited to areas where carpet tiles are used.

Carpet tile or broadloom carpet glued to concrete slab on grade floors should have an adhesive that is compatible with possible moisture from the slab.

Specify 10% overage on carpet.

All carpets and adhesives shall meet the Carpet and Rug Institute (CRI) Green Label Testing Program. Refer to www.carpet-rug.com. The purpose of this labeling program is to identify products that are truly low-VOC. The CRI Indoor Air Quality Carpet Testing Program informs the consumer that the product type has been tested by an independent laboratory and has met the criteria for very low emissions.

EMISSION FACTOR LIMIT	Mg/m2/hr
Total VOC: Carpets	**0.50**
4-Phenylcyclohexene	0.05
Formaldehyde	0.05
Styrene	0.40
Total VOC: Adhesives	**10.0**
Formaldehyde	0.05
2-Ethyl-1-Hexanol	0.30
Total VOC: Cushion	**1.00**
4-Phenylcyclohexene	0.30
Formaldehyde	0.05
Styrene	0.05

A. Specification Preferences

1. ***Performance***
   Specify "Branded" Type 6.6 Nylons, as they tend to outperform unbranded nylons due to the manufacturing process and the characteristics of the nylon being used. Being sustainable means the product will perform and last longer, hence reduce energy consumption to produce a newer replacement product and thus reduce premature disposal. More energy is ultimately consumed with a carpet that has a shorter use life span. Therefore, the County prefers performance branded Type 6.6 nylons over commodity products.

2. ***Local and Regional***
   Specify carpet products that are manufactured on the West Coast, with the exception of carpet tiles. There are several carpet mills that manufacture their carpet in California and we have selected from those manufactures. Even though the distance is greater than the preferred 500 mile radius of a product considered local and regional it is much closer than those products manufactured in Georgia. Using products that are manufactured locally helps reduce the environmental impacts resulting from their transportation and help supports the local economy.

3. ***Recycled Content***
   The carpet industry has responded to market demand for carpet fibers with recycled content. However, the results have not been as successful as possible. Recycled materials in the construction of commercial carpet have always been a challenge because of the long-term performance issues that commercial carpet demands. It is achievable to get some recycled content with Lumena solution-dyed nylons. Our specifications reflect that some solution-dyed nylons have a small percentage of recycled content. As mentioned above our selection criteria were based upon performance nylons, as opposed to nylons with recycled content. The industry has not perfected the development of Type 6.6 nylon with a high percentage of recycled

nylon, either post-industrial or post-consumer. Type 6.6 nylon may be custom ordered with recycled content, for a minimum quantity and some cost premium.

4. ***Carpet Tile***
   Carpet tile (as opposed to broadloom) may achieve a high percentage of recycled content nylon. Due to the advanced technologies of mills manufacturing carpet tiles and carpet tile backing, it is possible to use a carpet tile with a premium Type 6.6 nylon that has recycled content on the backing and face fibers.

   In addition to these products with high recycled content, C&A Floorcoverings Inc. will also take back and recycle any existing vinyl-backed carpet product, if you replace it with their product (e.g. Monterey or Crossley). Interface Inc. will take back any manufacturer's carpet and recycle it. To ensure recycling occurs, indicate such on the Purchase Order when the order is placed.

   Benefits of using Carpet Tile:
   - Provides flexible to change areas out with out changing entire floor
   - High recycled content on backing
   - Performance nylons
   - Works ideal with raised access floor system or open office system
   - Easy for selective replacement of tiles in high traffic areas
   - Minimum use of adhesive is required

5. ***Carpet Base***
   Where carpet base is specified, use matching carpet base with exposed edges bound and sewn.

BASIS OF DESIGN: BROADLOOM (clinics, healthcare facilities)		
	Product A	**Product B**
Manufacturer	Bentley Prince Street www.bentleyprincestreet.com	Tandus www.tandus.com
Fiber	Antron Lumena™ solution dyed nylon	
Fiber Type	Type 6.6	
Dye Method	Solution Dyed	Solution Dyed
Standard Backing	High PerformancePC™,	Super Lok
Premium Backing		
Moisture Barrier Backing	Optimum Barrier II	
Recycled Content	varies-	varies/A
Style	EncompassTall Story	Census 44020
Color Option A	8053 Longevity400409 Off Site Meeting *	Cinema
Color Option B	8050 Well-Being400416 8 Hour Day *	Eco Resort
Color Option C	5052 Growth400424 Earthquake Warning *	Radar

BASIS OF DESIGN: BROADLOOM (chambers, offices, libraries)			
	Product A	**Product B**	**Product C**
Manufacturer	Bentley Prince Street www.bentleyprincestreet.com	Tandus www.tandus.com	Atlas www.atlascarpetmills.com
Fiber	Ultron® Color cf nylon by Ascend		Antron Legacy Nylon
Fiber Type	Type 6,6		Type 6,6
Dye Method	Piece Dyed	Solution Dyed	
Standard Backing	High PerformancePC™,	Woven Polypropylene	Action-Bac
Premium Backing			
Moisture Barrier Backing	Optimum Barrier II		Permiam Bac MP
Recycled Content		N/A	Post Consumer and/or Post Industrial
Style	Designer Social	Groundwork	Chasse
Color Option A	888747 Public Tours	Cane	C717 Violet Lace
Color Option B	888750 Sculpture Garden	Carbon	C706 Florentine
Color Option C	888753 Hours and Admiss…	Moonstone	C713 Shellstone

BASIS OF DESIGN: BROADLOOM (detention facilities)			
	Product A	**Product B**	**Product C**
Manufacturer	PacifiCrest www.pacificrest.com	Tandus www.tandus.com	Shawwww.shawfloors.com
Fiber	Antron Brilliance & Primers		Eco*solution Q SDN
Fiber Type	Type 6,6		
Dye Method	Piece Dyed	Solution Dyed	Solution Dyed
Standard Backing	ActionBac	Crossweave	Polyproplene
Premium Backing			
Moisture Barrier Backing			
Adhesive			
Recycled Content	-	-	-
Style	Abstract	Elevation Grid 60121	Media J0062
Color Option A	0007	Concrete Form	62309 Network
Color Option B	0026	Dry-stone	62312 Books
Color Option C	0035	Timber Hitch	62204 Magazine

BASIS OF DESIGN: CARPET TILE (clinics, healthcare facilities, offices, libraries)			
	Product A	**Product B**	**Product C**
Manufacturer	Shaw www.shawfloors.com	Interface www.interfaceflor.com	Bentley Prince Street www.bentleyprincestreet.com
Fiber	100% Solution Q Nylon	Solutia Ultron ReNew Nylon	Dupont Nylon
Fiber Type		Type 6.6	Type 6.6
Dye Method	Solution Dyed	Solution Dyed	Solution Dyed
Standard Backing	Ecoworx	GlasBac RE Tile	Action Bac
Adhesive			
Recycled Content		52% min	100% post-consumer
Style	No Limits Tile	Transformation 146030250E	Benessere
Color Option A	69300 Boundless	4185 Pollen	880012 Mollare
Color Option B	69301 Infinity	4191 Conifer	880004 Devoto Amico
Color Option C	69302 Achievement	4189 Tundra	880015 Contento

EXHIBIT B10: PAINTING

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compounds (VOC).

A. Interior Paints

All paint products that are used in Multnomah County buildings shall comply with the **Green Seal Environmental Requirements** www.greenseal.org. This standard establishes environmental requirements for paints. The standard does not include stains, clear finishes, or paints sold in aerosol cans. Paints listed below meet the VOC limits as outlined by Green Seal in the USGBC LEED Green Building Rating System.

Interior Paint	**VOC Limit (grams/Liter)**
Flat	50
Non-Flat	150
Exterior Paint	**VOC Limit (grams/Liter)**
Flat	100
Non-Flat	200

Specify the following product(s) as the basis of design.

1. ***Sherwin-Williams Company***
   30 NE Broadway
   Portland, OR 97232
   (503) 288-6477
   www.sherwin.com
   Products: see table below.

BASIS OF DESIGN: INTERIOR PAINTING (all facilities) – Use Sherwin-Williams as Basis of Design			
Manufacturer	**Product**	**Finish**	**Color**
Sherwin-Williams	Latex	Eggshell	Polar White BC 37530
Sherwin-Williams	Latex	Eggshell	Coconut Spirit CW031W
Sherwin-Williams	Latex	Eggshell	Sheer Lilac 7970W
Sherwin-Williams	Latex	Eggshell	Frosted Glass 7530W
Sherwin-Williams	Latex	Eggshell	Misted Pollen 8140W
Sherwin-Williams	Latex	Eggshell	Delicate Cream 7720W
Sherwin-Williams	Latex	Eggshell	Naturel SW 7542

2. ***AFM Safecoat***
   3251 Third Avenue

San Diego, CA 92103
(800) 239-0321
www.afmsafecoat.com

Product: AFM Safecoat New Wallboard Primecoat HPV
Attributes: It is a premium quality, fast curing, and flat finish primer specially formulated to provide a superior prime coat over interior surfaces such as new gypsum wallboard and textured sheetrock. It equalizes the absorption rate of topcoat paints over a variety of surfaces with different porosities, and helps to eliminate decorating problems over textured sheetrock and tape joints on wallboard.

Product: AFM MetalCoat Acrylic Metal Primer
Attributes: It is a thermoplastic acrylic emulsion primer fortified with rust inhibiting pigments. Designed for use on non-ferrous metal, iron, steel, aluminum, galvanized and masonry, it is not recommended for copper. It provides a tough and flexible film, producing outstanding corrosion resistance and excellent adhesion. It may be used on both interior or exterior, including marine atmospheres. It has very low odor and low VOC. It is one of the least toxic metal primers available, formulated without the heavy metals and other hazardous ingredients commonly used.

Product: AFM Safecoat SemiGloss Zero VOC
Attributes: It is a premium quality, fast curing enamel designed for interior walls, ceilings, wallboard, properly cured and primed plaster, masonry and primed metal where a semi-gloss finish and superior film formation properties are needed. It is particularly well-suited for areas in which the health of the occupants is a concern: schools, hospitals, homes, offices, or anywhere people want to reduce their exposure to toxic chemicals. Safecoat paints have almost no odor during application and are odor free-once cured. They contain no formaldehyde, ammonia, crystalline silica, or ethylene glycol.

Product: AFM Safecoat Transitional Primer
Attributes: It is a premium quality, water-based, flat finish universal primer specifically formulated to solve difficult application problems without the use of toxic and malodorous chemicals. It is particularly well-suited for transitioning from existing oil-based painted surfaces to water-based coatings. Because it has an extremely tight and efficient polymer network, when properly applied it is useful as a stain blocker for knot holes, water soluble stains and the oils, tannins and terpenes in wood which can "bleed through" to the surface upon the application of traditional water-based primers. Like all Safecoat paints, it is the least toxic product of its type, and contains no naphtha or other aromatic solvents, and no formaldehyde, ethylene glycol, ammonia, acetone, heavy metals, crystalline silica or other carcinogenic or hazardous materials.

B. Sealers

Use sealers in your buildings that meet the following criteria for Bay Area Air Quality Management District. Refer to www.baaqmd.gov. The purpose of these criteria is to limit the quantity of volatile organic compounds (VOC) in architectural coatings.

Sealants	**VOC Limit (grams/Liter)**
Architectural	250
Sealant Primer	**VOC Limit (grams/Liter)**
Architectural (non-porous) Architectural (porous) Other	250 775 750
Specialty Coatings	
Wood varnish	350
Stains	250
Waterproofing concrete/ masonry sealers	400
Waterproofing sealers	250
Primers, sealers and undercoaters	200
Quick dry enamels	250
Quick dry primers, sealers, undercoaters	200
Recycled Coatings	250
Shellacs: Clear Opaque	 730 550

C. Lacquer Sealer for Metal and Wood

All sealers, caulking and adhesives listed below meet the VOC limits as outlined by the USGBC LEED Green Building Rating System. Specify the following product(s) as the basis of design.

1. ***American Fomulating and Manufacturing***
   3251 Third AvenueSan Diego, CA 92103
   (800) 239-0321
   www.afmsafecoat.com
   Product: Safecoat Acrylacq
   Attributes: It is a clear high-gloss water-based replacement for high solvent content lacquers. Use on wood cabinetry and doors, paneling, furniture, wood railings, metal railings. VOC material is 124 grams/Liter). VOC Material less water is 281 grams per Liter.

D. Concrete and Masonry Sealer

Specify the following product(s) as the basis of design.

1. ***AFM Safecoat***

   3251 Third Avenue
   San Diego, CA 92103
   (800) 239-0321
   www.afmsafecoat.com

   Product: AFM Safecoat Penetrating WaterStop
   Attributes: Improves water resistance and repellency in a wide variety of surfaces, including brick walls, concrete foundations, concrete block, stucco, stone and most unglazed tile. Because Safecoat Penetrating WaterStop is not toxic and low odor, it is ideal for use indoors instead of a typical high solvent content sealer; yet, it is durable enough for use outdoors. It is particularly useful as a periodic maintenance coat for surfaces originally treated with Safecoat WaterShield.

   Product: AFM Safecoat Safe Seal
   Attributes: It is a multi-use, water-based, low-gloss sealer for highly porous surfaces such as particle board, plywood, processed wood and porous concrete. It is used primarily to reduce toxic out-gassing. In particular, it is highly effective at sealing in formaldehyde out-gassing from processed wood such as plywood, particle board and pressed wood. It is virtually odorless on application and odorless once cured. Use on porous surfaces such as processed wood products, concrete, wood.

E. Doors and Trim

Specify the following product(s) as the basis of design.

1. ***Sherwin Williams Company***

30 NE Broadway
Portland, OR 97232
(503) 288-6477
www.sherwin.com

Product: ProMar 200
Attributes: Interior waterbased acrylic-alkyd semi-gloss low odor paint. Very durable paint which works well in high impact locations such as doors and door trim.

F. Pavement

1. All traffic control markings comply with the MUTCD and/or the ODOT Traffic line manual.
2. All paint used is "Low VOC, Non Lead, solvent borne traffic paint". This is applied at a minimum of 15 mils wet.
3. Stall lines are "Yellow", except ADA areas.
4. ADA/ Handicap parking stalls, access aisles, and legends are "White", installed to current ODOT Standards, and marked using "Premark" brand preformed thermoplastic, 125 mil thickness lines, 90 mil thickness legends, all "High skid resistant" material.
5. Traffic legends (arrows, stoplines, crosswalks, etc.) are marked using FHWA style markings. These are marked using "Premark" preformed thermoplastic, 125 mil thickness.

EXHIBIT B11: SPECIALTIES

GENERAL NARRATIVE

Incorporate the following basis of design into the appropriate architectural sections of the specifications. Specify products that emit low volatile organic compounds (VOC).

A. Plastic Toilet Compartments

Recycled plastic is an excellent material for toilet partitions, due to the non-structural requirements of the product and the durability and cleanability of the material. These following products use recycled high-density polyethylene (HDPE) post-consumer plastic. Depending on the product, recycled content may vary from 30% to 75%. Specify the following product(s) as the basis of design.

1. ***Scranton Products***
   801 East Corey Street
   Scranton, PA 18505
   (800) 445-5148
   www.scrantonproducts.com

2. ***Bradley Corporation*** W142 N9101 Fountain Boulevard
   Menomonee Falls, WI 53051
   (800) 272-3539
   www.bradleycorp.com

B. Cabinetry

1. Hinges
   a. For cabinet hinges use: RPC five-knuckle overlay hinges as basis of design. Substitutions must be reviewed/approved by Multnomah County Carpenter's Shop.

APPENDIX C: Mechanical Basis of Design

EXHIBIT C1: LANDSCAPE IRRIGATION SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for landscape designers and others to be used in the design and renovation of facilities for Multnomah County. Design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements with approval from Multnomah County. See related Plumbing System Design Guideline.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary. The County prefers that no irrigation systems be used with the exception of irrigation during the first year of establishing newly planted native plants.

☐1. The type of irrigation system selected (drip, mist, bubbler, rotating impact head, etc.) shall be consistent with optimizing water distribution for the plant materials and areas under irrigation. Basis of design: Hunter, Rainbird, or Toro. For large areas of turf, basis of design: Hunter type 'I-40" heads.

a. ***Hunter***
1940 Diamond Street
San Marcos, CA 92078
Tel: (1) 760-744-5240
www.hunterindustries.com

b. ***Rainbird***
970 West Sierra Madre Ave.
Azusa, CA 91702
www.rainbird.com

c. ***Toro***
8111 Lyndale Avenue South
Bloomington, MN 55420
(800) 348-2424
www.toro.com

☐2. Irrigation systems shall be equipped with an anti-siphon backflow prevention device in the form of an approved pressure vacuum breaker or as instructed by the AHJ. For a double check valve assembly, basis of design: Watts 007.

a. ***Watts***
815 Chestnut Street
North Andover, MA 01845
Phone: (978) 688-1811
www.watts.com

☐3. Require a licensed plumber to provide the point of connection (POC) of the domestic line and the irrigation system backflow assembly.

☐4. Irrigation systems shall be controlled by programmable, electronic controllers to permit efficient use of water. All system mains and laterals shall be installed with a minimum depth of 18 inches below grade. Design and equip the system for winterizing by compressed air evacuation.

☐5. Provide a sub-meter inside the property line near the domestic water meter. Sub-meter shall be installed in approved vault with allowance for service. Note date of installation for City of Portland sewer credit program. Requirements for meter:
   a. Registers in cubic feet capable of BAS remote read.
   b. Serial number is embossed or stamped into the lid of the register.
   c. Totaling register of the “odometer” type.
   d. Black digit on white dial with the two right most dials with white digits on a black dial or background.
   e. Indicates not less than 98.5% and not more that 101.5% of the water actually passing through the meter at any rate of flow within the meter design limits.
   f. Non-fogging registers.

☐6. All irrigation pipe and fittings shall be made with Schedule 80 rigid PVC or Schedule 40 steel pipe.

EXHIBIT C2: PLUMBING SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for mechanical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County. See related Landscape Irrigation System Design Guideline and Fire Protection Standards elsewhere.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary.

☐1. The plumbing systems within the building shall be a commercial grade and domestically manufactured. Below ground domestic water systems shall be Type K below buildings. Above ground domestic water systems shall be Type L copper with some exceptions for small extensions or branch lines of existing galvanized systems. No pipe straps allowed. Sanitary, vent, and storm sewer shall be cast iron no-hub with heavy-duty couplings for underground piping when work is accomplished under Division 15 (standard couplings may be used in Tier 3 buildings and when approved by MTS). All other sanitary and storm sewer shall be cast iron no-hub. Vent piping may be ABS.

☐2. Division 2 site water and sanitary sewer systems: The use of ductile iron pipe or cast iron is preferred over PVC. Cast iron and ductile iron pipe lasts 100 years, whereas polyethylene pipe only lasts fifty years. Cast iron and ductile iron pipe consists of 100% recycled material (Source: Environmental Resource Guide). PVC pipe lacks the strength of iron pipe and needs compacted bedding and tracer locator wires. Repairs present a problem and it is highly subject to expansion/contraction and vulnerable to vacuum and buckling.

County occupied non-residential buildings only (except tenant areas):

☐3. Provide water filters on all chilled water coolers. (AP-200 for ice machines, Insta-Hot units and chilled water coolers must be pre-purged prior to filling the tank to prevent charcoal particulate contamination)

☐4. Each floor of a building shall have a drinking fountain or water cooler.

☐5. Domestic hot water systems shall have re-circulating pumps where appropriate to assure hot water to remote fixtures.

☐6. Break room sinks (or kitchens without stoves to heat water) shall be equipped with a commercial, instant hot water faucet.

☐7. All kitchen dishwashers shall be furnished with ventilation hoods. When sanitizing is required (180 deg), provide stainless steel sleeve in dishwasher opening to avoid destruction to wood cabinetry.

B. The following items should be addressed in all new and remodeled facilities that are owned by the County and might be applicable to long-lease facilities, where instructed by the County. County-owned retail spaces may deviate from the guideline with Project Manager approval.

☐1. Plumbing fixtures in security and detention areas shall be stainless steel. Where required to match existing, acceptable security ware fixtures are Bradley, Wiloughby, or Metcraft. Basis of design: Acorn.

a. ***Bradley Corporation***
W142 N9101 Fountain Blvd.
Menomonee Falls, WI 53051
(800) 272-3539
www.bradleycorp.com

b. ***Willoughby Industries, Inc.***
5105 West 78th Street
Indianapolis, IN 46268
(800) 428-4065
www.willoughby-ind.com

c. ***Metcraft Industries, Inc.***
301 SE Thompson Drive
Lee's Summit, MO 64082
(866) 382-7238
www.metcraftindustries.com

d. ***Acorn Engineering Company***
15125 Proctor Avenue
City of Industry, CA 91746
(800) 488-8999
www.acorneng.com

☐2. Piping over electrical rooms containing main distribution panels or motor control centers shall be avoided where possible. When piping is necessary in these areas, indicate leakage protection drawings or in specifications.

☐3. All mixing valves shall be designed for easy maintenance and long life. Basis of design: Powers.

a. ***Powers***
815 Chestnut Street
North Andover, MA 01845
(800) 669-5430
www.powerscontrols.com

☐4. Metering fitting. Basis of design: Powers.

☐5. Lavatory and sink faucets: Specify durable finishes for detention and security areas. Basis of design: Chicago or American Standard.

a. ***Chicago Faucets***
2100 S. Clearwater Drive
Des Plaines, IL 60018-5999
(847) 803-5000
www.chicagofaucets.com

b. ***American Standard***
1 Centennial Plaza
Piscataway, NJ 08855
(800) 442-1902
www.americanstandard-us.com

☐6. Lavatory: All lavatories shall have hot and cold water supplies. Provide rigid chrome plated supply pipes and stops and chrome plated outlet and trap drains. Provide chrome plated pop-up drains or stainless steel grid drains. Basis of design: American Standard.

☐7. Shower fittings: Provide solid brass fitting with polished chrome finish. Basis of design: American Standard.

☐8. Urinals shall be white vitreous china wall-mounted with chrome plated supplies, chrome-plated flush valve and stainless steel strainers for each drain opening as recommended by urinal manufacturer. Basis of design: American Standard low consumption type fixture.

☐9. Water closets: Water closets shall be white vitreous china with chrome plated supplies. Furnish with manufacturer's suggested open front white seat with stainless steel check hinge/post. Wall-mounting is preferred. Basis of design: American Standard or Briggs.
a. ***Briggs***
300 Eagle Road
Goose Creek, SC 29445
(800) 888-4458
www.briggsplumbing.com

☐10. Provide all plumbing fixtures from a single manufacture, if possible. Where applicable, all fixtures shall be white. Basis of design: American Standard.

☐11. Eye/Face wash stations: Provide non-tempered water delivery unless directed otherwise. Basis of design: Haws.
a. ***Haws Corporation***
1455 Kleppe Lane
Sparks, Nevada 89431
(888) 640-4297
www.hawsco.com

☐12. Water coolers and drinking fountains: Water coolers with remote chillers above the ceiling are not allowed. Basis of design: Haws or Elkay.
a. ***Elkay***
2222 Camden Court
Oak Brook, IL 60523
(630) 574-8484
www.elkayusa.com

(630-574-8484

☐13. Flush Valves: All flush valves shall be manually operated, except where subject to vagrant use. Basis of design: Royal Sloan.
   a. Infrared Flushers: Shall not be equipped with manual override flush buttons on the side because they are subject to vandalism. Basis of design: Sloan or Zurn.
      i) ***Sloan***
      10500 Seymour Ave.
      Franklin Park, IL 60131
      (800) 982-5839
      www.sloanvalve.com

      ii) ***Zurn Industries, LLC***
      1801 Pittsburgh Avenue
      Erie, PA 16502
      (855) 663-9876
      www.zurn.com

☐14. Install sufficient isolation valves on main branch lines to shut off sections of the building's domestic water system for maintenance. Use bronze ball valves – 2" and smaller.

☐15. Buildings which are in operation 24 hrs/day (like a jail, not a residential building), critical buildings and high rises shall be furnished with two backflow devices of identical size, make, and model on separate lines. All other non-residential buildings shall have a second backflow device one-half size of the main backflow device on a service loop to avoid shutdown during regular business hours. Require a licensed plumber to provide the point of connection (POC) of the domestic line and the irrigation system backflow assembly. Basis of design: Febco or Conbraco.
   a. ***Febco***
   815 Chestnut Street
   North Andover, MA 01845
   Phone: (800) 767-1234
   www.febcoonline.com

   b. ***Conbraco***
   701 Matthews-Mint Hill Road
   Matthews, NC 28105
   (704) 841-6000
   www.apollovalves.com

☐16. Complete and fully automatic fire protection systems shall be provided in accordance with the National Fire Protection Association (NFPA) and/or County's Insurance Underwriter for all non-residential buildings. All plans must be approved by Insurance Underwriter and be in an acceptable format. Refer to complete Fire Protection Standards elsewhere.

☐17. Natural gas pipe shall be schedule 40 steel screwed on 2-1/2 inches and below and over 2-1/2 inches welded.

☐18. Domestic water heaters shall be natural gas type where feasible. Water heaters over 100 gallons shall be standard commercial grade and have a 10 year warranty. Do not specify PVI. Provide high efficiency and energy star approved water heaters.

☐19. Avoid point-of-use electric water heaters (exception: Insta-Hot) when a central system is available.
   a. ***InSinkErator (Insta-Hot)***
   4700 21st Street
   Racine, WI 53406
   (262)554-5432
   www.insinkerator.com

☐20. Provide floor drains or floor sinks at all "wet" equipment (i.e. ice machines, boilers, etc.) and as required for wet cleaning of floors. Restrooms with two or more stalls require a floor drain. Provide removable stainless steel mesh in addition to grilled drain cover to prevent entry of large particles of waste which might cause stoppages. Location of floor drains and floor sinks shall be coordinated to avoid conditions where locations of equipment make removal of covers for cleaning difficult. Slope floor to drain.

☐21. Structural requirements for seismic restraints for all supported and suspended piping, including their attachment to the building structure, shall be reviewed and approved by a structural engineer when they are not shown on the drawings.

☐22. Use sectional glass fiber insulation on all domestic cold and hot water piping except under lavatories designed for handicapped usage use flexible foam plastic insulation.

☐23. In all "wet" environments, floor cleanout plugs shall be stainless steel. At all other locations in finished areas, cleanout plugs shall be bronze.

☐24. Equip all floor cleanouts, floor drain grates, and access panels with vandal proof screws where accessible to the public or in contact with inmates.

EXHIBIT C3: BOILER SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for mechanical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County.

A. The following items should be addressed in all owned and maintained facilities. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary.

☐1. Instantaneous type copper finned tube boilers are not allowed. Size boilers to allow standardization of replacement modules. Full boiler diagnostics shall be

located on the front of the boiler. Basis of design: Honeywell controls. High efficiency only. Warranties: 10 years. Basis of design: Ajax, Modcon.

a. ***Ajax***
2701 S. Harbor Blvd.
Santa Ana, CA 92704
(714) 437-9050
www.ajaxboiler.com

b. ***Modcon***
HTP, Inc.
PO Box 429
120 Braley Road
East Freetown, MA
(800) 323-9651
www.htproducts.com

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☐2. Where possible, the number and arrangement of boilers shall be designed to provide heating to the facility despite the breakdown or routine maintenance of any one boiler. For larger systems (over 40K SF) specify two boilers such that each unit can handle 100% of the total heating load, and select two heating/hot water pumps that can each simultaneously deliver 100% of the required flow. For small systems, specify a single boiler with a single pump for the full capacity (pump controlled independently). Always provide redundant equipment or a supplemental heating source in 24/7 operations, such as a jail.

☐3. On large buildings (over 40K SF), boiler accessories including feed pumps, heat circulating pumps, etc., shall be designed to provide both normal and standby service.

☐4. An air separation device at the high point (i.e. Hoffman) should be supplied to eliminate trapped air. The system must also have a properly sized bladder type expansion tank installed close to the boiler on the suction side of the system pump.

☐5. Piping must be supported by padded hangers or floor stands allowing for expansion, contraction, and to reduce transmission noise. Follow current code requirement for seismic restraints.

☐6. The boiler controls shall be provided with a digital dry contact that interfaces with the Building Automation System when the boiler is in any alarm condition. A Hand-Off-Auto (HOA) switch shall also be provided on the boiler control and dedicated boiler water circulation pumps which allows for manual on and off and enable/disable override.

☐7. Do not locate boilers outside unless absolutely necessary. Boiler rooms shall be provided which have dedicated combustion air and are isolated from fans and other equipment. They shall be neat in appearance. All equipment shall be set on housekeeping pads at least 4-inches above the floor and the floor shall be sealed with a suitable surface. Box floor drains 6-8 inches deep shall be provided with the floor sloped to drain. The boiler blowdown should be piped to the drain.

☐8. Servicing clearances shall exceed the minimum by 25% wherever possible. The total volume of the space where the boiler is installed shall be at least sixteen times the total volume of the boiler unless direct venting is provided. Exhaust fans located in boiler rooms shall not deplete the combustion air supply and/or cause a down draft in the venting system.

☐9. With or without secondary pumps, heating water boiler flow shall be constant unless otherwise designed and approved by the boiler manufacturer.

☐10. Secondary HW pumps shall be considered for any heating water system in which the boilers are not rated by the manufacturer to accept the expected extremes of HW flow, should 2-way coil valves be used. In this application an end-of-line three-way bypass and control valve is required. Secondary pumping systems shall also be considered where the design HW flow is greater than 200 gpm.

☐11. Engineering design should avoid boiler shock cased by low entering water temperatures entering the boiler. Hot water reset should only be on the secondary loop. Do not attempt to adjust firing rates and setpoints at the boiler controls.

☐12. The design should provide unions and valves at the inlet and outlet of the boilers so they can be isolated for service.

☐13. Water connections at the boilers must be full size with no reducing bushing that could decrease the flow and result in boiler noise or other serious consequences.

☐14. Burner management systems shall meet Industrial Risk Insurers (IRI) requirements.

☐15. Boiler Manufacturer shall review and approve design application and installation.

☐16. Boiler Manufacturer representative shall conduct start-up of the equipment. Avoid the use of spec language that can be interpreted to allow persons other than the Boiler Manufacturer's official representative to conduct start-up. Allow up to two hours with Commissioning agent for post start up coordination and testing. Perform boiler blow-out in the presence of the Owner.

☐17. Boiler Manufacturer official representative shall instruct Owner personnel in operation and maintenance. The O & M manual for the equipment shall be provided to the County Trades at the time of demonstration. All start-up sheets shall be included in the package. Allow up to two hours of demonstration time.

☐18. Fit all boilers with dual low-water cutoffs complying with requirements of governmental agencies having jurisdiction.

☐19. Boilers shall have electronic boiler controls with electric ignition and low silhouette vents.

☐20. Heating water piping shall be black steel pipe, schedule 40 threaded or welded or Type K copper.

EXHIBIT C4: CHILLER SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for mechanical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County.

A. The following items should be addressed in all owned and maintained facilities. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary.

☐1. For optimum chiller plant efficiency, the plant must be designed to operate efficiently at low loads. The operation of a smaller chiller loaded to a greater percent of minimum is preferred to operating a single chiller at or near its minimum recommended value.

☐2. Induced draft cooling towers shall be equipped with two-speed fans, not variable speed. Forced draft preferred.

☐3. Chillers should be provided with environmentally friendly (non CFC) refrigerant and selected for high efficiency of 50 KW/ton or better, if possible.

☐4. Avoid the use of hot gas bypass because it falsely loads chillers and results in a significant waste of energy. In applications where the unit air flow is low (less than 250 cfm/ton), the use of hot gas bypass is required to prevent the evaporator coil from freezing in conditions of unusually low load. Apply to lead compressors for VAV/VVT and make up air units.

☐5. Piping must be supported by padded hangers or floor stands allowing for expansion, contraction, and to reduce transmission noise.

☐6. Provide minimum one pump per chiller.

☐7. When remodeling an existing system, consider installing adjustable speed drives on the existing chilled water and condenser water pumps, if feasible.

☐8. All secondary chilled water pumps shall be of identical capacity and head. An individual VFD shall control each such pump.

☐9. Secondary chilled water pumping systems shall be considered for all situations where the total chiller plant capacity is greater than 50 tons, where any cooling coils are not close to the chiller, and where there is sufficient load diversity that the chiller plant can be expected to operate at less than 80% capacity more than 25% of the time.

☐10. If total project area exceeds 25,000 square feet, the cooling system shall consist of a central chilled water system. DX cooling shall be considered only on a case-by-case basis.

☐11. For buildings requiring less than 240 tons of cooling capacity, the preferred solution is an air-cooled chiller with two or more modules> 40 tons shall include multiple scroll compressors, and dual independent refrigerant circuits. Basis of design: Multistack.

☐12. Use modular chillers in all applications. Basis of design: Multistack.
a. ***Multistack, LLC***
PO Box 510
1065 Maple Ave.
Sparta, WI 54656
(608) 366-2400
www.multistack.com

☐13. Chiller Manufacturer representative shall conduct start-up of the equipment. Avoid the use of spec language that can be interpreted to allow factory trained personnel or other persons other than the Chiller Manufacturer's official representative.

☐14. Chiller Manufacturer official representative shall instruct Owner personnel in operation and maintenance. The O & M manual for the equipment shall be provided to the County Trades at the time of demonstration. All start-up sheets shall be included in the package. Allow up to two hours of demonstration time.

☐15. Provide Point List (I/O) Summary in construction bid documents. Provide BAS interface directly to chiller controls. No gateways.

EXHIBIT C5: FIRE PROTECTION SPRINKER SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

Multnomah County (the County) considers fire protection sprinklers a desirable and critical life safety and property conservation feature of all its buildings. As such, planners and designers of remodels and new construction shall include fire protection sprinklers in projects for the County. In the projects where fire protection sprinklers will not be included, the A/E Service Provider shall assist the Project Manager to prepare a Life Safety and Property Conservation report for management approval.

A. Fire Protection Sprinkler Systems

1. The Life Safety and Property Conservation Report shall have sections that address each of the following topics:

a. Risk of loss of life in the building without fire protection sprinklers;
b. Risk of property loss due to fire with the maximum value of building and contents calculated;
c. Potential loss of use of the building to the County and/or the public;
d. Loss in public confidence of the County to act as a steward of public property in the event of a fire; and
e. Applicable codes.
f. No report is required if fire protection sprinklers are included in the project.

2. Fire protection sprinklers shall be specified, designed, and constructed for a 50-year life span. Other goals are good engineering practice, a biddable project, and easy to maintain system. To meet these design goals, certain design standards are better than code minimum.

3. A Professional Engineer, registered in Oregon, with a specialty in Fire Protection Engineering and approved by the County shall write fire protection sprinkler specifications for all County projects that include sprinklers. The Fire Protection Engineer shall complete a written submittal review of the component manufacturer's data sheets, sprinkler shop drawings, and hydraulic calculations prior to the installation of the sprinkler system.

Quality Assurance

4. Qualifications: Company specializing in fire sprinkler systems of similar type and scope with a minimum three years experience.

5. Company shall obtain and pay for all necessary permits for installation of a complete fire sprinkler system.

6. Apply the edition of codes enforced by the Authority Having Jurisdiction.

Submittals

7. 95% Construction Documents (CD) fire protection sprinkler specifications to County's property insurance provider.

8. Component manufacturer's data sheets, shop drawings, and hydraulic calculations (as one complete stand-alone package) to AHJ and Fire Protection Engineer. Provide proof of approval by AHJ of installed sprinkler system to Engineer on completion of work. Coordinate sprinkler system design with all other building systems.

9. Project Record Documents indicating as-built conditions as specified in Division 1 or one reproducible and two prints.

10. Test Reports: Underground and above ground piping hydrostatic test, water supply flow test: Code-required acceptance test: and manufacturer's operation and maintenance data.

11. Operations and Maintenance Manual: O & M manuals shall include Record Drawings, hydraulic calculations, manufacturer's data sheets, operation & maintenance instructions, servicing requirements, test reports, certificates, and NFPA 25.

B: Fire Protection Sprinkler System Description

1. Multnomah County requires all occupancies, except residential, to be provided with sprinkler coverage to no less than an Ordinary Hazard Group 1 level of protection. This includes all occupancies, even those that by code would be allowed to be protected by Light Hazard sprinkler coverage.

2. Each hazard within a building shall be described as a building section, occupancy classification per NFPA 13, sprinkler density, area of operation, maximum area per sprinkler, inside hose stream demand, and outside hose stream demand.

3. Hazards likely to be found in County buildings include office, health care, correction, animal control, road shops, courts, library, and residential.

4. Sprinkler system design shall include a 5-psi cushion for a demand point less than 50 psi, a 10 percent cushion for a demand point between 50 and 100 psi, and a 10-psi cushion for a demand point above 100 psi. A 15-psi cushion shall be provided if the sprinkler system is provided with a fire booster pump. The cushion shall be between the demand point and the water supply curve.

Flow Test

5. Water flow test data shall be included in the sprinkler specifications. Flow test data shall include static water pressure, flow rate, residual water pressure, location of flow test, test time & date, and who provided the information.

6. Judgment by the Fire Protection Engineer shall be used as to the suitability of the flow test in terms of location to project site and date of test.

Products

7. Pipe and fittings shall be of domestic manufacture.

8. Unlined cast iron should be avoided for all underground fire sprinkler systems.

9. Ferrous sprinkler pipe:
   a. 2-inch and smaller shall be Schedule 40 or better. UL listed or FM approved.
   b. 2 ½ -inch and larger shall be Schedule 10 or better. UL listed or FM approved.
   c. Ferrous sprinkler pipe used in dry pipe systems shall be galvanized inside and out.

10. Copper pipe with threaded, brazed, soldered, or mechanical fittings only. Glued fittings are not allowed.

11. Mechanical coupling and fittings: UL listed or FM approved.

12. Plastic pipe is allowed in residential occupancies only.

13. Air compressors for dry pipe and preaction systems shall be manufactured for sprinkler systems. Basis of design: Emglo, Gast, or General.

a. ***Emglo***
701 East Joppa Road
Baltimore, MD 21286
(888) 883-6456
www.emglo.com

b. ***Gast Manufacturing, Inc.***
2300 M-139 Highway
Benton Harbor, MI 49023
(269) 926-6171
www.gastmfg.com

c. ***General Air Products***
118 Summit Drive
Exton, PA 19341
(888) 595-0375
www.generalairproducts.com

14. Sprinkler heads:
    a. Shall be standard response only where allowed by the AHJ.
    b. Remodel areas shall match existing heads as close as practical.
    c. Shall be institutional type in holding cells, jails, interviewing rooms, or other areas where detainees may be left unattended.
    d. Unique sprinkler applications shall be specified by the Fire Protection Engineer.

Installation

15. The backflow prevention device for the fire sprinkler lead-in shall be approved by the local jurisdiction and the State of Oregon. Basis of design: Cla-Val, Conbraco, Febco, Watts, or Zurn.

    d. ***Cla-Val***
    1701 Placentia Ave.
    Costa Mesa, CA 92627
    (800) 942-6326
    www.cla-val.com

    e. ***Conbraco***
    701 Matthews-Mint Hill Road
    Matthews, NC 28105
    (704) 841-6000
    www.apollovalves.com

    f. ***Febco***
    815 Chestnut Street
    North Andover, MA 01845
    Phone: (800) 767-1234
    www.febcoonline.com

    g. ***Watts***
    815 Chestnut Street
    North Andover, MA 01845
    Phone: (978) 688-1811

www.watts.com

h. ***Zurn Industries, LLC***
1801 Pittsburgh Avenue
Erie, PA 16502
(855) 663-9876
www.zurn.com

16. Utility Vaults:
    a. Valves in the flow path of fire protection sprinklers shall have hard-wired tamper switches.
    b. Provide an electrically powered sump pump within the utility vault including separate underground conduit for power.

17. Above ground sprinkler pipe:
    a. Install pipe to minimize obstruction to other work.
    b. Install pipe in concealed spaces above finished ceilings.
    c. Center heads in the middle or quarter points of suspended ceiling tile.
    d. Coordinate support of pipe 4-inch and larger with a structural engineer.
    e. Route flow test discharge water to a location that can accept the volume from a wide-open drain test that will not cause damage, including to landscaping.
    f. Provide access panels for all test valves, test drains and low point drains concealed by structure or finish.

EXHIBIT C6: FIRE PUMP SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

Fire pumps are contemplated to be required in areas with low water pressure relative to building height, in occupancies with large fire sprinkler water demand and in high-rise buildings.

A. Fire Pumps

1. Fire pumps shall be specified, designed, and constructed for a 50-year life span. Other design goals are good engineering practice, a biddable project, and easy to maintain system. To meet these design goals, certain design standards are better than code minimum.

2. A Professional Engineer, registered in Oregon, with a specialty in Fire Protection Engineering and approved by the County shall write the fire pump specifications for all County projects that include fire pumps. The Fire Protection Engineer shall complete a written submittal review of the component manufacturer's data sheets, fire pump shop drawings, and hydraulic calculations prior to the installation of the fire pump system.

3. Careful consideration shall be given to specifying the electric fire pump motor starter in any design where the motor is estimated to be in excess of 35 horsepower or in all designs where onsite emergency power is provided to the fire pump.

Quality Assurance

4. Qualifications: Company specializing in fire pumps of similar type and scope with a minimum three years experience.

5. Company shall obtain and pay for all necessary permits for installation of a complete fire pump.

6. Apply the edition of codes enforced by the Authority Having Jurisdiction (AHJ).

Submittals

7. 90% Construction Documents (CD) fire pump specifications to County's property insurance provider.

8. Component manufacturer's data sheets, shop drawings, and hydraulic calculations (as one complete stand-alone package) to AHJ and Fire Protection Engineer. Provide proof of approval by AHJ of installed sprinkler system to Engineer on completion of work. Coordinate sprinkler system design with all other building systems.

9. Project Record Documents indicating as-built conditions as specified in Division 1 or one reproducible and two prints.

10. Test Reports: Code-required acceptance test: and manufacturer's operation and maintenance data.

11. Operations and Maintenance Manual: O & M manuals shall include Record Drawings, hydraulic calculations, manufacturer's data sheets, operation & maintenance instructions, servicing requirements, test reports, certificates.

System Description

12. The Fire Protection Engineer shall estimate the fire pump capacity, boost, and horsepower requirements. The fire pump contractor shall complete final fire pump sizing.

13. On electric fire pump motors over 35 horsepower, a wye-delta closed transition reduced voltage starter shall be installed unless the Fire Protection Engineer and project Electrical Engineer specify otherwise.

Products

14. Jockey Pump manufacturer. Basis of design: Grundfos.
    a. ***Grundfos***
    Poul Due Jensens Vej7
    DK-8850 Bjerringbro
    Denmark
    (913) 227-3400 (USA)
    www.grundfos.com

Installation

15. Provision shall be provided to discharge fire pump test flow to atmosphere.

EXHIBIT C7: STANDPIPE SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

Standpipes shall be specified, designed, and constructed for a 75-year life span. Other design goals are good engineering practice, a biddable project, and easy to maintain system. To meet these design goals, certain design standards are better than code minimum.

A. A Professional Engineer, registered in Oregon, with a specialty in Fire Protection Engineering and approved by the County shall write the standpipe specifications for all County projects that include standpipes. The Fire Protection Engineer shall complete a written submittal review of the component manufacturer's data sheets, standpipe shop drawings, and hydraulic calculations prior to the installation of the standpipe system.

Quality Assurance

1. Qualifications: Company specializing in standpipe systems of similar type and scope with a minimum three years experience.

2. Company shall obtain and pay for all necessary permits for installation of a complete standpipe system.

3. Apply the edition of codes enforced by Authorities Having Jurisdiction (AHJ).

Submittals

4. 90% Construction Documents (CD) standpipe specifications to County's property insurance provider.

5. Component manufacturer's data sheets, shop drawings, and hydraulic calculations (as one complete stand-alone package) to AHJ and Fire Protection Engineer. Provide proof of approval by AHJ of installed sprinkler system to Engineer on completion of work. Coordinate sprinkler system design with all other building systems.

6. Project Record Documents indicating as-built conditions as specified in Division 1 or one reproducible and two prints.

7. Test Reports: Underground and above ground piping hydrostatic test, water supply flow test: Code-required acceptance test: and manufacturer's operation and maintenance data.

8. Operations and Maintenance Manual: O & M manuals shall include Record Drawings, hydraulic calculations, manufacturer's data sheets, operation & maintenance instructions, servicing requirements, test reports, certificates, and NFPA 25. As part of the project deliverables, complete the Project Closeout Transmittal (FPM121) listing new equipment and its manufacturer, model number, serial number, size and warranty information.

Products

9. Pipe and fittings shall be of domestic manufacture.

10. Ferrous standpipe pipe:
    a. 2-inch and smaller shall be Schedule 40 or better. UL listed or FM approved.
    b. 2 ½ -inch and larger shall be Schedule 10 or better. UL listed or FM approved.

11. Mechanical coupling and fittings: UL listed or FM approved.

EXHIBIT C8: HVAC SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for mechanical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County. See related sections elsewhere; Boiler Design Guidelines, Chiller Design Guidelines, Control System Design Guidelines, Mechanical Commissioning Guidelines, and Mechanical and Control Guidelines for Project Planning and Development.

A. The following items should be addressed in all facilities whether leased or owned. Also applies to buildings other than Tier 1 and 2. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary. For County-owned residential occupancies, apply minimum code requirements for HVAC systems with a provision for a 7-day programmable thermostat control. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

Capacities

☐1. When operations in the building are scheduled 24/7, the system shall be designed using, at a minimum, the geographical summer and winter outdoor design conditions of 10°F Winter - 100°F Summer dry bulb/68°F wet bulb. All other buildings shall be designed for 10°F Winter - 90°F Summer dry bulb/66°F wet bulb.

☐2. The system shall be capable of maintaining, at design conditions; the following temperature fluctuations during occupied hours, in all areas (including Conference Rooms and Training rooms at maximum people load) served by the HVAC system:

    a. Heating: 68-78° F (with a mean temperature target of 70° F with a normal control [drift] limited to +/- 2° F and dead-band of 5°F within which supply of heating energy to zone is shut off or reduced to minimum.)

    b. Cooling: 70-77° F (with a mean temperature target of 72° F with a normal control [drift] limited to +/- 2° F and dead-band of 5°F within which supply of

cooling energy to zone is shut off or reduced to minimum.) Detention areas 78 º F cooling and kitchen areas 80 º F cooling.

Distribution

☐3. Group spaces/ HVAC zones/rooms/ and areas of similar thermal occupancy so that offices are with offices and not with dissimilar rooms. Don't put east offices with south offices, etc. In general, corner spaces should be treated separately. Isolate areas which are often unoccupied if possible and provide separate units/zones for areas which are occupied after hours or on weekends. This does not apply to residential occupancies.

☐4. Systems that serve zones with dissimilar cooling and heating loads, and that have terminal units with no means of reheat are generally not acceptable.

☐5. Do not provide separate zoning for rest rooms, vestibules, and corridors.

Exhaust Provisions

☐6. All toilet rooms shall be exhausted at 100 cfm/toilet fixture.

☐7. All toilet rooms, lunch rooms, high use copier rooms or other rooms generating smoke or odors shall be exhausted directly to the exterior without re-circulating.

☐8. All enclosed rooms shall have supply and return or exhaust provisions. This includes electrical, mechanical, recycle, storage, and other rooms. Powered exhaust must be used for boiler rooms, central storage, etc.

☐9. All toilet exhaust and fume hood exhausts shall be connected to constant volume exhaust systems. Booster fans are generally not allowed.

☐10. X-ray darkrooms shall be designed to continuously exhaust at a rate of 12 air changes per hour.

☐11. Independent systems required: Chapter 5, IMC, states that exhaust systems from bath, toilet, urinal, locker, service sink closets and similar rooms shall be independent of other exhaust systems. Type I or Type II hoods shall be installed in kitchens above all commercial food heat-processing appliances. Considering this code requirement, whenever any tenant retail spaces are proposed for future, consideration shall be given to providing adequate exhaust and makeup air ducts for toilet rooms and kitchens.

☐12. Non-commercial clothes dryer vents which exceed an equivalent of 20-feet in length shall be equipped with a booster fan at the terminus. Tied to operation of dryer or provided with timer mechanism. Code requires cleanouts at every change in direction. Access must be provided to the cleanout for maintenance. Basis of Design: Greenheck G-series.

a. ***Greenheck***
PO Box 410
Schofield, WI 54476
(715) 359-6171
www.greenheck.com

Controls

☐13. All HVAC systems shall have a programmable setback capability. The system shall be setback/setup during unoccupied hours as follows:
   a. Heating setback: 10 – 15° F, not to drop below 55° F.
   b. Cooling setup: Shall not allow temperature to exceed 85° F.

☐14. Tel/data and computer rooms shall be designed to maintain separate temperature range from main HVAC system. Design for lower end of the temperature tolerance of 72 + 2º F. Design to maintain positive pressure with minimum outside air. A separate system shall be installed to act independently of the main system. Successful designs have incorporated a separate TU box on the main air handler for day mode and an inline exhaust with plenum discharge and transfer grille for night mode. Ductless split systems are also encouraged when feasible to minimize treatment of outside air. Units should be specified for low ambient operation. Provide alarm to the Central Station activated whenever the temperature exceeds 85º F. Not applicable to small telephone closets. PK units shall have a program timer. Basis of Design for cooling only ductless split system: Mitsubishi Series MS or PK with matching outdoor unit and BAS interface.
   a. ***Mitsubishi Electric & Electronics USA, Inc.***
      HVAC Advanced Products Division
      3400 Lawrenceville Suwanee Rd.
      Suwanee, Georgia 30024
      (800) 433-4822
      www.mitsubishicomfort.com

Indoor Air Quality:

☐15. Standard filterization shall be rated 25-30% efficiency per ASHRAE standard 52-76. Basis of Design: 2" thick pleated throw away type filters with welded wire support. Basis of Design: Farr 30/30, Air Handler.
   a. Provide MERV 13 rating for LEED buildings.
      i) ***Farr Air Pollution Control***
      3505 South Airport Road
      Jonesboro, AR 72401
      (877) 780-1451
      www.farrapc.com

      ii) ***Air Handler (W. W. Grainger, Inc.)***.
      100 Grainger Parkway
      Lake Forest, IL 60045
      (800) 472-4643
      www.grainger.com

☐16. Internal insulation on terminal units shall be designed to prevent fiberglass entering the air stream.

☐17. VAV box minimum air volumes should not create a stuffy environment – never allow the minimum air volume to fall below four air changes per hour when the zone is occupied. All plans shall have equipment schedules indicating min/max air volume.

☐18. To avoid stagnant air in occupied spaces, design for at least .8 – 1.0 ft2 air movement.

Quality Assurance

☐19. The HVAC system shall be designed by a registered, professional, mechanical engineer specializing in HVAC systems, and the HVAC drawings shall bear his or her State of Oregon stamp.

☐20. All HVAC systems shall be tested and balanced prior to occupancy by a professional system balancer. Actual test and balance data shall be taken from field measurements by certified technicians and instruments. Note deficiencies and provide reports to the County.

Noise

☐21. Transfer Ducts in Conference Rooms and Private Offices: Include at least one elbow to maintain privacy and minimize transference of sounds to adjacent spaces. Use oversized flex duct in lieu of rigid ductwork. Provide interior sound attenuation.

☐22. Avoid designs which situate fans in ceilings over occupied spaces to minimize fan noise transference and facilitate maintenance.

Energy

☐23. Specify high efficiency units when possible (A SEER of 12 or better, when available in size required). Higher EER is not the complete answer to reducing energy costs. Properly size the unit, keep infiltration and leakage losses to a minimum, increase building insulation, and reduce unnecessary internal loading.

Other

☐24. Economizer Cooling: Each fan system shall have an air economizer system capable of modulating OSA & return dampers and powered exhaust to provide up to 100% of the design supply air quantity as outdoor air. Only in certain cases will the County allow areas to reduce the amount of mechanical ventilation or to use operable windows for primary ventilation. Though natural window ventilation for some rooms may be employed, mechanical ventilation should be available.
Economizer basis of design: MicroMetl, Honeywell.

a. ***MicroMetl***
905 Southern Way
Sparks, NV 89431
(800) 884-4662
www.micrometl.com

b. ***Honeywell International***
101 Columbia Road
Mailstop - M6/LM
Morristown, NJ 07962
(877) 841-2840
www.honeywell.com

☐25. All TB isolation rooms and Respiratory Precaution Rooms in new buildings shall be designed to provide greater than 12 air changes per hour, provide 90 percent supply filtration on supply, 100% exhaust, greater than 125 cfm differential between supply and exhaust, 0.01 in w.g. pressure differential, and have low exhaust and high supply air directed into the room. All fans associated with TB isolation rooms shall be dedicated (independent from other systems) constant volume units and on emergency power or shall have a contingency plan for power outage approved by the occupants. Redundant or back-up systems are generally not needed for Respiratory Precaution Rooms. Note: TB Isolation Rooms shall be a sealed room with walls to structure or hard capped ceilings with less than 0.5 sq. ft. leakage. Where converting an existing building, apply reasonable measures to meet the requirements as much as possible.

☐26. Air Handling equipment schedules shall indicate the area served by each unit.

☐27. All new mechanical equipment shall have a unique identifier. For instance, if there are four identical exhaust fans, they should each be identified by a unique label like EF-1 or EF-2, regardless of their similarity in capacity. Always coordinate with Facilities Management and existing naming strategy. The exception to this requirement is for small residential bathroom exhaust fans.

☐28. All fire dampers shall be dynamically rated. Fusible links are preferred. Combination Fire/Smoke dampers meeting UL Standard 555 and 555S (Multi-blade dynamic rated).

☐29. For electrical equipment spaces such as UPS rooms, etc., provide an accurate load calculation to ensure that adequate cooling is provided without excessive equipment and utility costs or excessive air velocity. Intake air must be effectively filtered to keep dust and other contaminants from building up in the electrical equipment.

B. The following items should be addressed in all new and remodeled facilities that are owned by the County and might be applicable to long-lease facilities, where instructed by the County. Normally not relevant to Tier 3 buildings. For County-owned residential occupancies, apply minimum code requirements for HVAC systems with a provision for a 7-day programmable thermostat control. See Residential System choices below for further information. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

System Choices

☐1. If total project area exceeds 25,000 square feet, the cooling system should consist of a central chiller/cooling tower. DX cooling shall be considered on a case-by-case basis.

☐2. VAV systems should be designed with fan and duct system static pressure regulation to limit duct pressure build-up and poor operating performance. The static pressure controller should reset both the supply air fan and return air fan. Building static sensor should be installed on each floor.

☐3. In the schematic phase of a project, the engineer shall present the County with system options for consideration prior to design development. For instance, for free-standing buildings, evaluate the life cycle cost and feasibility of a chiller, boiler, and air handling system versus a roof-mounted, self-contained packaged system. The analysis should be based on a minimum 20-year life cycle assumption, a future discount factor of 7 % annually, and all cost variables such as operation and maintenance.

☐4. VAV systems incorporating more than six terminal units shall be considered central air handling systems for the purpose of applying these guidelines.

☐5. Future modification and expansion as defined by the County (appropriate for buildings that are subject to a change of use or occupancy or buildings that are planned for future expansion. Not appropriate for medical clinics, for instance)
   a. Size equipment and systems for future expansion
      1) Distribution main runs shall have 15% expansion capability
      2) Air-side equipment shall have 15% additional capacity
   b. Position equipment and systems for future modifications. (For example, add space for future cooling coil, etc.)

☐6. All heating coils should be hot water. Electric coils shall be avoided in almost all applications. If electric reheat coils are used, low airflow protection must be provided (i.e. airflow switch).

☐7. Heat pump systems and all-electric systems are generally not favored. If a building has a central system, additions or remodels to the building should expand the existing mechanical system. Expansion of central systems is not required when a separate system is needed to isolate tenant utility bills or when a zone schedule varies appreciably from the remaining zones on the central system.

☐8. All clinic exam rooms shall have radiant ceiling heat panels.

Residential System Choices:

☐9. Provide high efficiency direct vent gas furnaces.

☐10. Provide high efficiency (over 90%) condensing units and heat pump units to provide 12 to 18.0 SEER.

☐11. Provide an electronic air cleaner with pre-filter to improve indoor air quality.

☐12. All habitable rooms shall be provided with heating facilities capable of maintaining room temperature of 70 degrees.

Distribution and Other Design Considerations:

☐13. No diversity should be used in sizing duct branches and run-outs to terminal units.

☐14. All return air systems should be ducted and well distributed. Ceiling return plenum designs with return air through light fixtures are generally not acceptable. If a ceiling return plenum is required due to ceiling space limitations, provide adequate return air openings in sufficient location and quantity to assure good air

circulation. Generally design return openings closest to the return intake at 500 fpm and return openings farther away at 200 fpm.

☐15. Provide equipment that uses non CFC-based refrigerants when available in size (usually > 5 tons) and configuration from selected manufacturer.

☐16. Electric motors 1 hp or more and which serve built-up HVAC systems shall have efficiencies corresponding to values set forth in the current code. This rule does not apply to packaged equipment.

☐17. Variable Speed Drives: Fan and pump motors of 25 hp and greater which serve variable flow systems shall be controlled by a variable speed drive.

☐18. Simple system Relief Dampers: Includes supply fan and economizer with relief dampers. Locate relief damper close to the space (e.g., behind a louver over the exit doors). Provide motorized damper operation to reduce leakage. When packaged unit relief damper options are inadequate in the opinion of the engineer, provide a separate relief system, such as a roof-mounted relief hood with barometric or motorized dampers.

☐19. Medium to Complex system Powered Relief/Exhaust: Includes powered-relief or powered-exhaust with capacity control to maintain building pressure within an acceptable range, e.g. variable-speed drives, discharge dampers, or multiple staged fans. Design shall prevent potential problems with fluctuating building pressure controls, negative building pressures at low outdoor air rates and control instability with high pressure drop return air systems. For constant volume systems, a return fan is required.

☐20. The bottom of outdoor air intakes serving central systems shall be as high as practical, but at least 6 feet above ground level.

☐21. Heat recovery should be evaluated by the engineer for systems with significant dehumidification requirements or 100% exhausted areas, if deemed appropriate by the Owner.

☐22. Mitered elbows in supply and return ducts are not allowed except where unavoidable when obstacles are encountered during the construction process. Construction documents should not indicate acceptance of mitered elbows where radius elbows can be used.

☐23. DX coils should have wide fin spacing to reduce the affect of frost build up on low temperature applications.

☐24. Design ductwork at 0.05”/100’ pressure drop, if space and system allows, to reduce velocities and to reduce system pressure requirements.

☐25. Upsize air handling unit cabinets to reduce velocities through the fan cabinets to approximately 400 fpm.

☐26. Specify mini-pleat type filters as a strategy for reducing average pressure drop across filters.

☐27. Where appropriate, select direct drive plug fans as a strategy for eliminating drive losses and maximizing overall mechanical efficiency of fans.

☐28. Rooftop gas equipment shall be provided with flue extensions to extend flue above the unit.

☐29. All ventilation equipment for emergency generators shall be connected to emergency power. All back-up cooling equipment for telecom/data rooms and computer room AC systems in critical buildings (as defined by County) shall be connected to emergency power. (Coordinate with Electrical standards)

☐30. Use perimeter heaters where wall/glass construction dictates high loads. The perimeter heating system shall also be used to maintain winter set-back temperatures during unoccupied hours and shall be either in the form of floor-mounted, finned tube radiant heaters, fan coil units, or other radiation systems consistent with design.

[Rule of Thumb: If heat loss exceeds 450 Btu/Hr. per lineal feet of wall, heat should be provided from under the window or from the base of the wall. If heat loss is between 250 and 450 Btu/Hr. per lineal feet of wall, heat should be provided from under the window or from the base of the wall. If heat loss is less than 250 Btu/Hr. per lineal feet of wall, heat should be provided from under the window or from the base of the wall, or from overhead diffusers located adjacent to or slightly away from the perimeter wall, discharging air directed at or away from the exposed wall or windowed area.]

☐31. Provide flexible connections at point of connection to equipment in all ductwork systems connected to air handling units, fans, and other equipment.

☐32. All rectangular duct taps should be made with 45 degree fittings.

☐33. All ductwork shall be constructed of sheet metal, except where flex duct is provided for attachment to grilles and diffusers. Other exceptions may include return air or transfer ducts upon approval.

☐34. Balancing Dampers: All supply and return branch ducts shall have balancing dampers, regardless of the length of the duct runs. Avoid using balancing dampers in the grille neck (opposed blade dampers). If a solid ceiling is present, provide an access hatch.. At branch ducts, provide manually operated dampers of the type and arrangement shown on the drawings, two gauges heavier than the duct in which installed, and equipped with locking quadrants.

☐35. Where existing ductboard is discovered during the design phase of a remodeled area, the engineer shall provide recommendations for repair or replacement.

☐36. Air Distribution Products: Shall be by the same manufacturer.

☐37. Central air handling systems with hydronic systems equipment. Basis of design: Haakon, Huntair, or Racan Carrier.

a. ***Haakon***
11851 Dyke Road
Richmond, BC V7A 4X8, Canada
(604) 273-0161

www.haakon.com

b. ***Huntair***
19855 SW 124th Ave.
Tualitin, OR 97062
(503) 639-0113
www.huntair.com

c. ***Racan Carrier***
2025, boul. Dagenais Ouest
Laval, QC, Canada H7L 5V1
(866) 466-8796
www.racan.ca

☐38. Rooftop packaged equipment: Basic of design: Carrier or Bryant.
a. ***Carrier***
One Carrier Place
Farmington, Connecticut 06032
(800)227-7437
www.carrier.com

b. ***Bryant***
3909 North College Ave.
Indianapolis, IN 46205
(800) 428-4326
www.bryant.com

☐39. Heat Pump packaged units. Basis of design: Carrier 38YKC (18,000-60,000 BTUHS).

☐40. Water source heat pumps shall be furnished with condensate pumps with non-adjustable float switches for intermittent pump operation and a secondary float that activates a safety switch wired to cut off the heat pump if the condensate pump fails. Basis of design: Little Giant deep well pump.
a. ***Little Giant***
301 N Macarthur Boulevard
Oklahoma City, OK 73127
(800) 701-7894
www.little-giantpump.com

☐41. Direct Expansion Fan Coil Units. Multi-speeds and quiet, efficient operation should be the criteria for selection.
i. For up to 7.5 tons. Basis of design: Carrier FA, FB, or FC Series or better.
j. For small tonnage units. Basis of design: Carrier FV4A Series.

Controls

☐42. All central HVAC control systems shall be remotely adjustable from Facilities and Property Management main headquarters at 401 N. Dixon. The following types of control systems are acceptable:
a. Siemens (only for large buildings and built-up systems)

a. ***Siemens***
300 New Jersey Avenue
Suite 1000
Washington, D.C. 20001
(800) 743-6367
www.usa.siemens.com

☐43. Electrical equipment and Elevator equipment rooms shall be designed to maintain 80 º F maximum temperatures. If mechanical cooling is not required, a thermostatically controlled, dedicated ventilation system shall be provided to remove heat. Not applicable to small electrical closets.

Indoor Air Quality

☐44. Where appropriate, specify UV-C or other microbial control systems for general disinfection with a pre-filter.

☐45. Where applicable, design all building spaces at a positive pressure relative to the outside.

☐46. The mechanical design shall indicate on the plans the required minimum outside air CFM for each air handling unit.

☐47. The use of upper-room ultraviolet germicidal irradiation technology is encouraged as an economical and effective substitute for increased mechanical air exchange rates in homeless shelters, medical exam waiting rooms, and jail waiting rooms and holding cells where County employees may be subjected to exposure to poor air hygiene and increasing communicable airborne disease transmission. (Lumalier, for example)

☐48. Duct wrap is preferred unless lining is needed for acoustical purposes or where ductwork is exposed or the quantity of work is minimal. If duct lining is used, it shall be a rigid liner board made from glass fibers bonded with resin, protected on the edges with an acrylic coating. If existing lined ductwork is reworked in a renovation project, the liner seams and punctures shall be resealed. Basis of design: Permacote Linacoustic R-300 made by Johns Manville or ToughGard by Certainteed.

a. ***Johns Manville***
717 17th St
Denver, CO 80202
(303) 978-2000
www.jm.com

b. ***Certainteed***
750 East Swedesford Road
Valley Forge, PA 19482
(800) 233-8990
www.certainteed.com

Quality Assurance

☐49. All test and balancing at County buildings shall be performed by a firm certified by the NEBB or AABC Approved firms: Air Balancing Specialty, Inc, Accurate Balancing Agency, Inc., Neudorfer Engineers, Inc., Northwest Engineering Services, Inc., Professional Air Balance Service, and Pacific Coast Air Balance.

☐50. Equipment Manufacturer representative shall conduct start-up of the equipment. Avoid the use of spec language that can be interpreted to allow factory trained personnel or other persons other than the Manufacturer's official representative.

☐51. HVAC Equipment Manufacturer official representative shall instruct Owner personnel in operation and maintenance. The O & M manual for the equipment shall be provided to the County Trades at the time of demonstration. All start-up sheets shall be included in the package. Allow up to two hours of demonstration time.

☐52. All rooftop gas equipment shall have at least two stages of heat and scroll compressors with unloading capabilities. Basis of design: Carrier

☐53. Projects with any HVAC and/or automatic controls require some level of commissioning by an approved commissioning agent. The Commissioning Agent is hired by the County. Use the County Commissioning Master Specification in the construction documents to inform the contractor of responsibilities and coordination efforts required.

C. The following items shall be considered for all County owned and maintained facilities, except Tier 3 facilities. Not applicable to residential occupancies.

☐1. Provide UL approved power shutoff with disconnect lockout protection on HVAC equipment. Switch shall be externally accessible.

☐2. Provide a covered externally accessible 115-V convenience outlet with 15-amp GFCI receptacle on rooftop equipment.

☐3. Provide a hose bib within 50 feet of cooling equipment for maintenance, where appropriate.

☐4. Provide hinged access panels permanently mounted to rooftop units, for the filter/indoor-fan motor, compressors, evaporator fan, and control box areas. Provide "tie back" retaining devices to hold the doors in the open position while servicing the unit.

☐5. Provide easy access to components: locate at floor level, or provide ladders, access doors, and platforms. This applies to pumps, valves, compressors, fans, motors, gauges and meters, drives and gear boxes, etc.

☐6. Provide space for access, to work, remove, and replace components. Include space around the pumps, compressors, and other typical components. Include space to inspect, work on, and pull components, including items such as boiler tubes.

☐7. Rooftop units (chilled water cooling only) over 40 tons shall be built-up systems designed with walk-in service corridors to permit maintenance personnel to service the equipment without being exposed to the elements. Basis of design: Haakon.

☐8. Fans serving exhaust systems located at the discharge are preferable.

☐9. Roof exhaust fans shall be curb-mounted with hinged or removable cover for easy access. Where practical, exhaust fans shall have V-belt drives, with 1.5 service factor and adjustable sheave on the motor.

☐10. Engineering design options shall consider redundant equipment for all 24-hour operations.

☐11. Air-handling duct systems shall be designed with accessibility for duct cleaning, and shall meet the requirements of NFPA 90A.

☐12. Choose water coils which have drainable circuits to facilitate cleaning.

☐13. Where surface-mounted piping on roof surfaces is unavoidable, provide a minimum 18” clearance under all multiple pipes and ducts over 30-inches wide for roof maintenance. Provide 12’’ clearance for smaller ducts and pipes.

☐14. Provide accessible air duct grilles in jail cells. Provide grilles that are the correct grille size and patterning which is recommended by the National Institute of Justice suicide prevention guidelines. Return air applications shall consider the provision of an accessible filter at the grille. (“Corrections News” July/August 1999)

☐15. Coil racks on built up air handlers shall permit each individual coil in the coil bank to be pulled without disturbing the others.

☐16. Provide isolation valves on branch lines serving each floor, and each equipment connection. In large floors (over 40,000 sq.ft.) provide isolation valves for every quadrant.

☐17. All attempts shall be made to locate terminal units and fan coil units where they are accessible by no more than an 8-foot ladder and not in confined areas over desks, cubicle partitions, and equipment that cannot be moved. Ample room for access to the controls, fan assembly, and induction intakes shall be provided.

☐18. All duct smoke/fire detectors and damper locations shall be shown on the Mechanical Record Drawings and on a chart similar to a valve chart which lists type and location. This is a requirement for JCAHO facilities but would also be desirable at all County facilities to assist in NFPA required testing.

☐19. Drain pans on fan units with coils shall be removable and positively sloped in every plane to assure proper drainage and help maximize protection from microbial growth. For superior corrosion resistance, provide stainless steel drain pan.

☐20. Plenum unit fan assemblies shall be easily serviced. Provide a hinged, fold down and removable fan assembly.

☐21. Provide an area within mechanical room for storage of air filters, drawings, manuals, and operating instructions. If no mechanical room is provided, find a suitable space elsewhere for this purpose.

D. The following warranty items shall be considered for all County owned equipment, except residential. (Exception: Equipment on Tier 3 facilities)

☐1. Compressors shall have 5 year manufacturer's warranties.

☐2. Heat exchangers shall have 10 year manufacturer's warranties.

APPENDIX D: Electrical Basis of Design

EXHIBIT D1: ELECTRICAL SERVICE AND POWER DISTRIBUTION

GENERAL NARRATIVE:

This guideline is presented for electrical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County. See related codes and standards elsewhere; NFPA 70 (National Electrical Code), Oregon Specialty Code, Oregon Solar Specialty Code, Oregon Administrative Rules, NFPA 70E (Electrical Safety Code), OSHA 1910, OSHA 1926, National Electrical Installation Standards (NEIS), NFPA 70B, NFPA 79, NFPA 99, NFPA 20, NFPA 110, NFPA 111, NFPA 101, associated IEEE standards and Control Guidelines for Project Planning and Development.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

1. **Design Principles: General**
   a. Electrical devices shall be commercial grade or better
   b. Disconnecting means shall be defeatable and have lock out tag out capabilities
   c. Receptacles shall be color coded as follows:
      i) Red = Generator backup power available
      ii) Blue = UPS backup power available
      iii) Ivory, White, Brown, Gray = Normal power
      iv) Orange = Isolated ground
   d. Receptacles in public access areas shall be Tamper Resistant (TR)

2. **Electrical Equipment ID: Label Formatting**

_____	_____ -	_____ -	_____	_____
Voltage	Power	Equipment	Floor	Designator

Voltage: **2** = 120/208v **3** = 120/240v **4** = 277/480v
Power: **P** = Utility power **E** = Emergency backup power

Equipment: The equipment abbreviations will follow CAD standards except as shown below:

FMS=Fuel Monitor System
PRM=Propane, Remote, Main fuel tank
PSM=Propane, Skid, Main fuel tank
DRM=Diesel, Remote, Main fuel tank
DSM=Diesel, Skid, Main fuel tank
DRD=Diesel, Remote, Day fuel tank
DSD=Diesel, Skid, Day fuel tank
NGF=Natural Gas Fuel
GSM=Gas, Skid, Main fuel tank
ATS=Automatic Transfer Switch
MTS=Manual Transfer Switch
SSG=Synchronizing Switch Gear
EPS=Emergency Power Supply
EPSS=Emergency Power Supply System
MTR=Motor
GSP=Ground System Plate
DSC=Disconnecting Means
MDP=Main Distribution Panel
SDP=Sub Distribution Panel
IGP=Isolated Ground Panelboard
PNL=Panel-board
MCP=Motor Control Panel
MCC=Motor Control Center
LRC=Lighting Relay Control
SD=Service Disconnect
UPS=Uninterruptable Power Supply
UMB=UPS Maintenance Bypass
UBC=UPS Battery Cabinet
GEN=Generator
VFD=Variable Frequency Drive
XFMR=Transformer
HTR=Heater
UBW=Universal Bus Way

Floor: Is the floor level the equipment is located on.
Designator: Is a letter designator for multiple pieces of equipment located on the same floor.
exception-1 VFDs and motors shall have the equipment name at the end of the ID
ex. 4E-VFD-7D-AHU.1 4E-MTR-7D-AHU.1
exception-2 Lighting control panels shall not have a voltage or power designator
ex. LRC-4A
exception-3 Transformers have two voltage designators: primary and secondary
ex. 42P-XFMR-3B 24-XFMR-16G

Label: Shall be engraved and attached able to withstand the environment
Label size: Minimum 1" tall by 3" wide, lettering shall be a minimum of ½" tall
Label color: Label colors are to be as shown below:
Utility power and associated equipment = Black with White lettering
UPS power and associated equipment = Blue with White lettering
Generator power and associated equipment = Red with White lettering

3. **Panel-boards: General**
   a. Shall have Door-in-Door hinged covers
   b. Shall have bolt-on breakers
   c. Shall have a minimum of 20% spare capacity
   d. Shall not have any penetrating conduits smaller than ¾"
   e. Shall have a minimum of 4 spare conduits stubbed out of the top

4. Generators: General

a. Shall be Cummins, Caterpillar, Kohler or MTU
b. Shall have LAN communications capabilities
c. Shall have digital or analog/digital combination meters
d. Shall have remote generator monitoring capabilities
e. Shall have Veeder-Root remote fuel monitoring with LAN card communications
f. Veeder-Root shall have minimum fuel tank probe and leak/annular monitoring
g. Shall have a 24hr run fuel capability as standard
h. Shall have a 72hr run fuel capability if designated for business continuity
i. Battery chargers shall be OEM or Sens FC/A series
j. Shall have 1 operations and 1 repair manual at the equipment
k. Shall have 1 operations and 1 repair manual electronic copy for BDMC

i) ***Cummins***
1400 73rd Ave. NE
Minneapolis MN USA 55432
(800) 888–6626
www.cumminspower.com

ii) ***Caterpiller***
100 North East Adams Street
Peoria, Illinois USA 61629
(309) 675-1000
www.caterpiller.com

iii) ***Kohler***
444 Highland Drive
Kohler, WI 53044
(800) 544-2444
www.kohlerpower.com

iv) ***Veeder-Root***
125 Powder Forest Drive
PO Box 2003
Simsbury, CT 06070
(888) 561-7942
www.veeder.com

v) ***Sens***
1840 Industrial Circle
Longmont, CO 80501
(866) 736-7872
www.sens-usa.com

5. **UPS: General**
    a. UPSs shall be Eaton and have built in communications card
    b. Shall have remote battery monitoring as directed by the electrical shop
    c. UPSs that are not for lighting only shall have a maintenance bypass
    d. Lighting egress UPSs shall be wired for dark building concepts
    e. Shall have 1 manual at the equipment and 1 electronic copy for BDMC
        i) ***Eaton***
        8609 Six Forks Road
        Raleigh, NC 27615
        (800) 356 5794
        www.eaton.com

6. **VFD: General**
    a. Shall be ABB brand
    b. Shall have a maintenance bypass
    c. Shall have P1 communication capability
    d. Shall have 1 manual at the equipment and 1 electronic copy for BDMC
        i) ***ABB***
        16250 W. Glendale Drive
        New Berlin, WI 53151
        (800) 435-7365
        www.abb.com/us

7. **Distribution Transformers: General**
    a. Shall have the same letter designation in the equipment ID as the panelboard it supplies
    b. Shall identify if bonding occurs outside of the transformer

8. **Building Service: General**
    a. Shall have 1 manual at the equipment and 1 electronic copy for BDMC
    b. All breakers shall have the load identified
    c. Service label shall have voltage, phase, and available fault current identified

9. **Grounding: General**
    a. Panel-board ground bus bars shall not be used outside of a panel-board
    b. Ground plates shall be used and not smaller than 2” x 4” x ¼”
    c. Mechanical connections to ground plates shall be bolted not tapped
    d. Ground wires shall be installed with space to allow a clamp to easily go around the wire

10. **Work Space, Area, Room**
    a. Work spaces shall be clearly marked
    b. Electric rooms shall have signs clearly marking the room
    c. All signs and markings shall be suitable to withstand the environment
    d. All electrical rooms shall be no warmer than 80 degress Fahrenheit

11. Lighting Control: General

a. Panels shall have P1 communication capabilities
b. Shall be Blue Ridge panels
   i) ***Blue Ridge Technologies***
   1800 Sandy Plains Industrial Parkway Suite 216
   Marietta, GA 30066
   www.brtint.com

12. Motors: General

a. Motor control panels shall have adequate space for testing
b. Motor control panels shall be UL508 listed
c. Motors with VFDs shall have the input wiring in a separate raceway than the output wiring
d. Shall have 1 schematic and 1 list of materials at the equipment
e. Shall have 1 schematic and 1 list of materials electronic copy for BDMC

13. Heaters: General

a. Place an equipment ID label using a sharpie or a label maker on inside of the cover
b. Identify the circuit that feeds the heater using sharpie or a label maker

14. Transfer Switches: General

a. Shall have LAN communications capabilities
b. Shall have maintenance bypass as designated by lead supervising electrician
c. All transfer switches to data centers shall have maintenance bypass
d. Shall have 1 operations and 1 repair manual at the equipment
e. Shall have 1 operations and 1 repair manual electronic copy for BDMC
f. Automatic Transfer Switches must be Russelectric or ASCO. MTU or Zenith can only be used with Multnomah County representative approval.
   i) ***Russelectric***
   South Shore Park
   Hingham, MA 02043
   (800) 749-6000
   www.russelectric.com

   ii) ***ASCO***
   1050 Dearborn Drive
   Columbus, OH 43085
   (614) 888-0246
   www.asco.com

   iii) ***MTU***
   100 Power Drive
   Mankato, MN 56001
   (800) 325-5450

www.mtuonsiteenergy.com

iv) ***Zenith***
3135 Easton Turnpike
Fairfiled, CT 06828
(800) 431-7867
www.geindustrial.com

g. Automatic Transfer Switches for data centers shall be Russelectric.

15. Solar: General

a. Shall have micro-inverters
b. Shall have remote monitoring

16. Secured Locations

a. Shall have tamper proof screws
b. Receptacles shall be type TR

17. Hand Dryers

a. Hand dryers shall be energy efficient
b. New and replaced hand dryers in Libraries shall be World Dryer Slimdri

i) ***World Dryer***
5700 McDermott Drive
Berkeley, IL 60163
(800) 323-0701
www.worlddryer.com
Product: SLIMdri

EXHIBIT D2: LIGHTING

GENERAL NARRATIVE:

This guideline is presented for electrical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County. See related codes and standards elsewhere; NFPA 70 (National Electrical Code), Oregon Specialty Code, Oregon Administrative Rules, National Electrical Installation Standards (NEIS), NFPA 70B, NFPA 99, NFPA 101, associated IEEE standards, DOE regulations and Control Guidelines for Project Planning and Development.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

1. **General:**

    a. T8 lighting is standard fluorescent fixture.
    b. T5 lighting is restricted to Multnomah County approval.
    c. Parabolic lighting is restricted to hallways and walkways.
    d. Induction lighting offers extended life of 100,000 hours and are preferred in exterior and hard-to-reach fixtures.
    e. LED lighting use is encouraged due to long life and low cost in long term maintenance with Multnomah County approval.

2. **Space illumination:**

    a. Occupancy designated for office, waiting area or similar type use shall utilize diffused lighting.

3. **Color:**

    a. 3500K is the Multnomah County standard.
    b. 5100K lighting shall be used as authorized by Multnomah County.
    c. Lighting color shall be consistent with color in existing spaces.

4. **Maintainability:**

    a. The lighting should be accessible and easily reached from an 8’ ladder.
    b. Use pendant hung fixtures in cases with high ceilings if possible.

5. **Exit Signs and Egress lighting:**

    a. Exit signs should be LED.
    b. Exit signs shall be self-monitoring.
    c. Battery back-up ballasts shall be Lithonia power sentry or equivalent that has the quick disconnect wiring harness.

6. **Life cycle:**

    a. Design lighting to have 50,000 hour ratings or greater.

7. **Energy consumption:**

    a. Energy-efficient fixtures outside of proven technology shall be approved by Multnomah County.

8. **Energy Efficiency**:

a. ENERGY STAR qualified fixtures are desired.

9. Lighting Control:

a. The lighting designer must layout circuits to be compatible with Multnomah County BAS strategies.

10. Historic Fixtures

a. The County has a retrofit contract with Eleek, Inc. to preserve these key assets.

i) ***Eleek, Inc***.
PO Box 838
Redwood Valley CA 95470
(503) 232-5526
www.eleekinc.com

11. 3rd Party Certification:

a. Underwriters Laboratories (UL) listing must be obtained for any rebuilt fixtures (typically historic fixtures). Approved retrofit kits are acceptable.

12. Dimming Ballasts:

a. Avoid dimmable ballasts in most, if not all, situations because of excessive costs.

13. Dark Buildings/Dark Rooms:

a. Design facilities and lighting systems that enable turning off all the lights including egress path and exit signs when buildings, or portions of buildings, are unoccupied for significant periods of time, such as overnight.

EXHIBIT D3: ALARMS, ACCESS CONTROL, LOW VOLTAGE SYSTEMS

A Security

1. Design Principles: Layered Approach to Security

a. All exterior accessible points (doors, hatches, etc.) are to have security contacts which are to be wide gapped type to prevents false activation.
b. All reasonably accessible glass is to be monitored with acoustic glass break detection. Interior protection of motion detection (minimum dual technology PIR and microwave or better) to be strategically placed by area value and likelihood of traffic.

c. When a building is of sufficient size or use it is to be divided into separate controllable compartments (partitions) which will have there egress doors monitored (security contacts which are to be wide gapped type to prevents false activation) and interiors monitored with motion detection (minimum dual technology PIR and microwave or better.
d. High value areas to have additional security monitoring (ideally a separate security partition) and physically hardening of location.
e. Environmental sensors for off site reporting- such as temperature sensors in Telecom rooms and water leak detection sensors- are to be connected to the security panel.
f. Duress buttons are to be placed where there is interaction with public and assistance may be required. When the location is a fixed location these are to be hard wired (e.g counters) and wireless when these are attached to movable furniture. Reporting and annunciation will be coordinated with the client.
Product: ***Digital Security Controls (DSC)***
3301 Langstaff Road
Concord, Ontario, Canada
L4K 4L2
(905) 760-3000
www.dsc.com

B. Access

1. Design Principles:

a. Access control is appropriate for exterior doors, doors that provide separation from staff and public, along with doors that provide access to high value locations or areas that need tracking. RFID readers are the current technology used.
b. Doors are to be monitored for position, either with a door contact or sensor integral with the access hardware; also a request-to-exit device is to be used (currently PIR REX).
c. Forced opens are to be monitored and at times are also monitored by the security system as part of area protection.
d. Access and security system to be integrated to provide arming and disarming control by access control system.
e. Elevator control to allow individual floor control by user.
f. Where there are monitored guard stations, events and alarms will be provided along with instructions via the access system.
g. Magnetic locks are not to be used unless there are no other viable options.
h. Where possible maintain same access door hardware for location (strikes or electrified latch).
Products: Kantech (controllers, software, ioProx XSF card readers and cards)

i) Kantech
9 Roszel Road
Princeton, NJ 08540
(888) 526-8324
www.kantech.com

C. Fire

1. Design Principles:

a. At a minimum meet current code along with providing detection in all paths of egress, high value or critical locations. Voice evacuation system are preferred. All devices are to be addressable and "intelligent"
b. Mechanical labeling is to be used to identify all initiating devices with addresses as displayed on the annunciator. All labels shall be of sufficient size and font to be easily read.
c. On relays and monitoring devices, an additional mechanical label shall be installed describing the function of such device on the device and on its cover, i.e. "elevator ALT recall" .
d. Mechanical labeling is to be used to identify all notification devices numbered in sequential order for each circuit. The final device on the circuit shall also display that it is the end of line device.
e. Any junction box with more that 3 cables shall be connected with terminal blocks and mechanically labeled.
f. Any duct detectors installed above a ceiling or in an area not easily accessible, shall have a remote test switch installed.
g. Any junction box or panel shall be mechanically labeled. In addition, any fire alarm panel fed with 120VAC power, shall be mechanically labeled with the information of the electrical panel and its location on the inside cover.

Products: Notifier

i) ***Notifier***
12 Clintonville Road
Northford, CT 06472
(800) 289-3473
www.notifier.com

EXHIBIT D4: ELECTRONC SERVICES

A Electronic Services Standards

1. Closed Circuit Television (CCTV)

a. All cameras shall be IP based with appropriate resolution.
b. VMS shall be exacqVision Server/Edge or owner approved substitute.
c. Coverage shall at minimum include public entry, public waiting lobbies, elevator lobbies, exterior staff doors, and public/staff parking areas.
d. Video retention shall be 30 days of motion detected recording at 7/fps/full resolution.
e. IP Camera network switches shall be Layer 3 with IEEE 802.3af POE or better with 15% spare ports.
f. IP Camera data infrastructure shall comply with "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.
g. CCTV head end equipment shall be collocated in tell/data/LVE closet.

2. Nurse Call (Detention)

a. Detention Nurse Call systems shall be IP based with digital signal processing and have the capability of multiple master stations with external input for call steering capability.
b. The system shall have 20% supplied expansion capability.
c. The system shall be a closed industrial "air gap" secure network.
d. Network switches shall be Layer 3 with IEEE 802.3af POE or better with 20% spare ports.
e. Data infrastructure shall comply with the "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.
f. Nurse Call head end equipment shall be collocated in tell/data/LVE closet.

3. Intercom

a. Intercoms shall be Aiphone AX Series or owner approved substitute.
b. Master Stations shall be located at Security Guard posts and or Reception personal locations with external input for call steering capability.
c. Data infrastructure shall comply with the "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.
d. Intercom head end equipment shall be collocated in tell/data/LVE closet.

4. Telephone Paging

a. Paging system shall be of centralized amplifier configuration

b. Paging controller shall be Bogen PCM2000 or owner approved substitute.
c. Paging amplifier shall be 25/70volt with 25% overhead.
d. Minimum of 2 spare zones shall be provided on paging controller.
e. Speaker spacing shall be consistent with manufactures design guide.
f. All speakers shall have individual accessible volume controls.
g. Conference rooms shall have wall mounted volume controls.
h. No more than 6 speakers per 18/2 stranded shielded home run.
i. Cabling infrastructure shall comply with the "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.
j. Paging head end equipment shall be collocated in tell/data/LVE closet.

5. Sound Reinforcement (Courtroom)

a. The sound system shall be of a mix-minus configuration utilizing a Digital Automatic Matrix Mixer.
b. An active microphone splitter will be provided feeding the sound reinforcement system and the Courts PC based FTR recording system.
c. The mix-minus output configuration shall have a minimum of 4 zones. Judge, witness, attorney, and gallery.
d. 4 Channel 70V amplifier.
e. Microphone inputs shall be as follows: Judge, Judicial Assistant (JA), Witness, Attorney x2, and two wireless mics.
f. An infrared Assisted Listen Device system shall be installed to meet ADA requirements.
g. Programmable touch panel master volume control and input level control located at the JAs work station.
h. Remote speaker with volume control in JAs office.
i. Cabling infrastructure shall comply with the "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.
j. Sound Reinforcement head end equipment shall be collocated in tell/data/LVE closet.

6. Sound Reinforcement (Boardroom)

a. The sound system shall be of a mix-minus configuration utilizing a Digital Automatic Matrix Mixer to include digital signal processing (DSP).
b. The mix-minus output configuration shall have a minimum of 4 zones. Dias, presenters, gallery, and overflow gallery.
c. Digital telephone hybrid for offsite call in participation.
d. Phone bridge for offsite monitoring of audio presentations.
e. Integrated A/V projector with video conferencing capabilities.
f. Minimum 4 Channel 70V amplifier with 25% overhead.
g. Microphone inputs shall be as follows: Dias (multiple microphones), Clerk, Support Staff, Presenters x4, and two wireless microphones.
h. An infrared Assisted Listen Device system shall be installed to meet ADA requirements.
i. Programmable touch panel master volume control, input level control and lighting control to be located at the Board Clerks' work station.

j. Cabling infrastructure shall comply with the “Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS” document.
k. Sound Reinforcement head end equipment shall be collocated in tell/data/LVE closet.

7. Distributed Antenna System (Public Safety)

a. Ability to provide at least -85dBm signal quality thoughout the required coverage area in the building.
b. Supervised monitoring of system status by building fire notification system.
c. Cabling infrastructure shall comply with the “Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS” document.
d. DAS head end equipment shall be collocated in tell/data/LVE closet.

8. Distributed Antenna System (Cellular Provider)

a. Ability to provide at least -85dBm signal quality thought the required coverage area in the building.
b. Multiple carrier coverage to include but not limited to Verizon, Sprint and AT&T.
c. Cabling infrastructure shall comply with the “Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS” document.
d. DAS head end equipment shall be collocated in tell/data/LVE closet.

9. Sound Masking

a. Installed where required or requested by client.
b. Each controller will be capable of 6 zones with coverage of at least 72,000 square feet.
c. System will include 2 audio inputs programmable by zone for building notification or background music.
d. Zone independent equalizer and volume controls.
e. Configuration and control via networked browser based interface.
f. CAT-5 emitter wiring, with plenum rated emitters.
g. Cabling infrastructure shall comply with the “Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS” document.
h. DAS head end equipment shall be collocated in tell/data/LVE closet.

10. County Radio Communication Antenna System

a. Provide 4 each LMR-400 plenum/riser rated coax cables from building Security Desk/ Emergency Operations Center or designated location to exterior roof of structure.

b. Interior coax to be terminated in wall box with labeled N-Female coaxial connectors. Exterior coax to be terminated with N-Male coaxial connectors with appropriate weather sealing.
c. Roof penetration to be 3" conduit with weather head installed to County roofing system specifications.
d. Cabling infrastructure shall comply with the "Multnomah County COMMUNICATIONS FACILITIES REQUIREMENTS" document.

11. Detention Electronics System (DE)

a. DE System integration of door control, movement intercom, cell intercom, CCTV, duress alarms, interlock overrides, touch panels (HMI), and radio communication logging, shall be controlled by a Schneider Electric Modicon Quantum PLC (or owner approved substitute) and programmed with the Schneider Electric Unity Pro IDE.
b. Touch Panel HMI devices shall be of an open source hardware design consisting of an industrial Windows 7 PC running the Siemens WinCCFlex runtime HMI software. The HMI device shall be an ELO touch display or owner approved substitute.
c. Ladder logic, Scripting, and DFB programming techniques are approved; 'Boolean word manipulation' is not an acceptable programming technique.
d. Movement and Cell intercom shall be of Harding manufacture or owner approved substitute.
e. All CCTV matrix switching shall manipulate IP based video.
f. All field devices shall have relay isolation between device and PLC I/O.

12. Electronic Signage Controller

a. Self contained media playback hardware.
b. 1080P HDMI, USB, VGA, GPIO, Ethernet.
c. Interactive display capability.
d. Network enabled for administration and media updates
e. Free design and admin software package
f. Onboard real time clock for scheduled displays
g. Supports multiple media feeds

EXHIBIT D5: TELECOM AND IT

B. Telecom Standards

1. Entrance Facility Room

A. This is the location where communication utility services enter the building from outside Service Providers or Access Provider to service occupants of a building. Size of this room is directly determined by building square footage and number of floors. All communication rooms must have a two hour fire rating.
These services may be for:

- Campus distribution –Local area networks, private automatic branch exchange.
- An Inter-exchange Common Carrier.
- A Central station system for Fire or Burglar Alarms.
- A Community antenna television (CATV) network.
- A closed circuit television (CCTV) network.
- Building Automation Systems (BAS)
- Distributed Antenna System (DAS)
- Audio/Video System including Sound Masking systems

(Some of these services will have equipment located in Equipment Rooms & Telecom Rooms.)

2. Main Switchroom for Telephone and Data Networking Equipment

a. The main telephone equipment switch room typically houses the telephone switch (PBX) cabinets; equipment racks for data networking equipment; UPS equipment; the wall field for cross-connecting the equipment cables, riser cables, intercampus BET cables, and ILEC/CLEC entrance cables; a work station; security card access control units, and storage space for maintenance spares, tools and test equipment.

b. At Multnomah County, there are typically two types of switchrooms: 1) the main switchroom which houses the central PBX cabinetry that serves the entire campus; and 2) satellite switchrooms for remote PBX cabinets and data switches that are connected via leased or MC owned outside plant facilities back to the main campus switchroom. Since the main switch room for the campus is in place and rather permanent in nature, this facilities requirement addresses ***satellite switchrooms which typically are required for new off campus buildings or similar major facilities construction projects*** where it's more efficient and effective to install remote PBX cabinets versus extending additional plant facilities to serve extensions directly off the main PBX.

c. The minimum size requirement for a satellite switchroom is 12' x 15'. Minimum clear height in the room shall be 9.5 feet without obstructions with outside walls built to ceiling structure. The access door to the room shall be at least 42 inches wide and 80 inches high, with doorsill, **door swings out of room**, and shall be fitted with a card access entry lock. A minimum of two walls should be covered with rigidly fixed (3/4 trade size) A-C plywood preferably void free, 8ft. high, capable of supporting attached equipment. Plywood should be either fire rated or covered with two coats of fire retardant paint. If fire rate plywood is selected two coats of off white paint should be applied with fire rated stamp exposed for inspection. Must have 2 hour fire rated walls.

d. A separate power supply circuit serving the switchroom shall be provided and terminated in its own electrical panel. Power shall be sufficient to support the equipment load and supporting facilities for the switchroom. A 1-½ trade-size conduit shall be provided from the switchroom to the building-grounding electrode.

e. The preferred location for the switchroom is the first floor (or ground floor). It is desirable to locate the switchroom close to the main backbone network and building outside telephone company cable entrance site for ease of connectivity

to these network and distribution facilities. No water or other liquid pipes should be located above or run through communication rooms.

f. When selecting the room site, avoid locations that are restricted by building components that limit expansion such as elevators, core, outside walls or other fixed building walls. Ease of accessibility to the space is important for the delivery of large equipment. The switchroom shall be located away from sources of electromagnetic interference at a distance that will reduce the interference to 3.0 V/m throughout the electromagnetic frequency spectrum. Special attention shall be given to electrical power supply transformers; motors and generators; x-ray equipment; radio, cell phone or radar transmitters; and induction sealing devices. Need to avoid close proximity to elevator equipment room or exposed to vibration equipment like HVAC Chillers. The switch room shall be located with ready access to the main HVAC delivery system to ensure sufficient airflow and cooling.

g. HVAC shall be provided on a 24 hours a day, 365 days-per-year basis. The temperature and humidity shall be controlled to provide continuous operating ranges of 64° F to 72° F with 30% to 55% relative humidity. The ambient temperature and humidity shall be measured at a distance of 5 feet above the floor level, after the equipment is in operation, at any point along the equipment aisle. A positive pressure differential with respect to surrounding area should be provided.

h. The switchroom shall be provided with the proper fire suppression system. Appropriate portable fire extinguishers shall be provided and maintained within the switchroom. They should be located as close as practicable to the switchroom entry or exit. Additionally, some form of temperature alarm system should be installed to provide an early warning to a remote monitoring site of temperatures exceeding 75° F.

i. The interior finishes of the switchroom shall be light in color to enhance room lighting. The floors, walls, ceiling and door shall be sealed to reduce dust. The PBX/switch room should not have grid tile or hard lid ceiling, but walls need to run to structure with a minimum 9.5 feet in height. Flooring materials having antistatic properties shall be used. Lighting shall be a minimum of 540 lx (50 candles) measured 3 feet above the finished floor in the middle of equipment aisles between cabinets. One or more switches located near the entrance door to the room shall control the lighting. ***Lighting fixtures shall not be powered from the same electrical distribution panel as the telecommunications equipment in the room.*** Emergency lighting and signs should be properly placed in the room where absence of light would hamper emergency exit.

3. Telephone Rooms for Telephone and Data Networking Equipment

a. There shall be at least one terminal room per floor. Additional Telecom Room (TR) should be provided when the floor area exceeds 10,000 sq. ft. or the horizontal distribution distance to the workstation exceeds 90 meter (300 ft). Rule of thumb would not have a workstation more than 150’ from a TR. There are typically two size scenarios for terminal rooms: 1) The ideal situation where there is ample space to provide a minimum room size of 10 ft. by 7 ft. with a single door at least 36 inches wide and 80 inches tall, opening out; and 2) the limited space scenario where the TR size should be a minimum of 6 ft. wide and 60

inches deep, both of which are inside dimensions, provided the TR is accessed via double doors which swing out away from the Telecom Room (TR). In either scenario, the TR should be at least 9.5 feet high.

b. Each TR shall have sufficient power and lighting. MC's minimum power requirements are a dedicated 20 amp duplex power outlet per TR. Additionally, each TR shall have adequate airflow to ensure that operating temperatures do not drop below 50° F or exceed 80° F.

c. Telecom Rooms (TR) shall be "centrally located" on each floor, or located so that horizontal station wires runs to user work stations and phones do not exceed 200 feet. The preferred standard for workstations to be within 150 feet from TR. In a multi-story building TR's should be stacked in the core area of each floor.

d. Each TR shall have sufficient sleeves, slots, conduits, or similar floor penetrations necessary to allow for ease of installation of telecommunications cabling and wiring. Such penetrations shall be properly fire stopped per the applicable building codes. A minimum of two walls should be covered with rigidly fixed (3/4 trade size) A-C plywood preferably void free, 8ft. high, capable of supporting attached equipment. Plywood should be either fire rated and covered with two coats of white or light color paint. Detailed specifications document will be provide per project scope.

4. Horizontal Pathways

a. Horizontal pathways and spaces consist of structure that conceal, protect and support horizontal cables between the workstation outlet and the telecommunications terminal TR. When designing a building, the layout and capacity of the horizontal distribution systems must be thoroughly documented in the floor plans and other building specifications. FM PM or A&E design team must provide written specifications that the interstitial space is plenum or non-plenum return.

b. Every ceiling distribution system must provide proper support for cables from the telecommunications terminal TR to the work areas it serves. ***Ceiling panels, support channels (T-bars), and vertical supports are NOT proper supports.*** Ceiling conduits, raceways, cable trays, and cabling must be suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight. The pathways must have adequate support to withstand pulling the cables and be installed with at least 3 inches of clear vertical space above the ceiling tiles and support channels (T-bar) to ensure accessibility.

c. Cable trays, wire baskets, or ladder trays are to be designed and install by low voltage contractor. Design and implementation that requires seismic bracing that requires a seismic structured engineering should be included in A&E scope.

d. Fire rated devices for wall penetration shall be design by A&E and provided and install by low voltage contractor. All fire rated devices and sealers should be design and specified by A&E; provided and install by low voltage contractor.

5. Conduit

a. Conduit types include electrical metallic tubing, rigid metal conduit, and rigid PVC. Conduits shall be of the type permitted under the appropriate electrical codes. Metal flex conduit is not allowed due to cable abrasion problems and is not covered in this standard. Fish tape or pull cord/string shall be installed in all conduits. Standard work station wall outlet installation shall have at least a ¾" conduit from the 4 gang box with single gang mud ring extended into the interstitial space and stubbed with non abrasive grommet. No ring and string construction for vertical wall cable installation.

b. Any single conduit run extending from a telecommunications terminal closet shall not serve more than two communications outlets. Conduit shall be sized per Table 1.1 and be incrementally increased in size from the furthest outlet toward the telecommunications room. No section of conduit shall be longer than 30 m (100 ft) or contain more than two 90° bends between pull boxes. A third bend may be acceptable in a pull section without de-rating the conduit's capacity if the run is not longer than 10 m (33 ft) or the conduit size is increased to the next trade size. This third bend needs to have prior approval from MC Telecom project designer.

TABLE 1.1

CONDUIT			NUMBER OF CABLES								
INTERNAL DIAMETER		TRADE SIZE	WIRE O.D. mm (in)								
			3.3	**4.6**	5.6	6.1	7.4	7.9	9.4	13.5	15.8
Mm	(in)		(.13)	**(.18)**	(.22)	(.24)	(.29)	(.31)	(.37)	(.53)	(.62)
15.8	0.62	½	1	**1**	0	0	0	0	0	0	0
20.9	0.82	¾	6	**5**	4	3	2	2	1	0	0
26.6	1.05	1	8	**8**	7	6	3	3	2	1	0
35.1	1.38	1 ¼	16	**14**	12	10	6	4	3	1	1
40.9	1.61	1 ½	20	**18**	16	15	7	6	4	2	1
52.5	2.07	2	30	**26**	22	20	14	12	7	4	3
62.7	2.47	2 ½	45	**40**	36	30	17	14	12	6	3
77.9	3.07	3	70	**60**	50	40	20	20	17	7	6

6. Pull Boxes

a. Pull boxes shall be used for the following purposes:

1. Fishing the conduit run.

2. Pulling the cable to the box and then looping the cable to be pulled into the next length of conduit.

b. Pull boxes shall be placed in an exposed manner and location, and readily accessible. Pull boxes shall not be placed in a fixed, false ceiling space unless immediately above a suitably marked, hinged panel.

c. A pull box shall be placed in a conduit run where:

1) the length is over 30 mm (100 ft);
2) there are more than two 90° bends; or,
3) if there is a reverse bend in the run.

d. Boxes shall be placed in a straight section of conduit and not used in lieu of a bend. The corresponding conduit ends should be aligned with each other.

7. Surface Raceway

a. Surface raceway, consisting of base, cover, couplings, elbows, and similar fittings, mounts directly on wall surfaces at appropriate work levels to provide a continuous perimeter pathway. Telecommunications outlets are located in cover fittings along the raceway. The electrical contractor shall provide faceplates for the surface raceway.

b. The practical capacity for telecommunications wiring in perimeter raceways ranges from 30% to 60% fill depending on cable-bend radius. The pathway size shall be calculated as follows: the summation of the cross-sectional area of all cables divided by the percent (expressed as a decimal fraction) of fill.

8. Grounding and Bonding

a. The electrical contractor will be responsible to bring in the grounding system. Locations will be provided by MC Telecom Project Designer. ***Grounding shall meet the requirements of the NEC and additionally grounding bonding shall conform to ANSI/TIA/EIA-607.*** When applicable, horizontal cabling and connecting hardware must be grounded and bonded in compliance with ANSI/NFPA 70 requirements and practices. When grounding telecommunications cabling, ensure that the installation conforms to proper practices and codes (ANSI/TIA/EIA-607, ANSI/NFPA 70, and local building codes).

b. An approved ground is available at the telecommunications rooms for:
- Cross-connect frames.
- Patch panel racks.
- Active telecommunications equipment.
- Test apparatus used for maintenance and testing.

c. Design Specifications should be listed in a Master Format under the Construction Specification Institute (CSI). The Master Format:
- Division 25 – Integration Automation
- Division 27 – Communications
- Division 28 – Electronics Safety & Security

APPENDIX E: Building Control Basis of Design

EXHIBIT E1: LIGHTING CONTROL

GENERAL NARRATIVE:

This guideline is presented for electrical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County. See related codes and standards elsewhere; NFPA 70 (National Electrical Code), Oregon Specialty Code, Oregon Administrative Rules, National Electrical Installation Standards (NEIS), NFPA 70B, NFPA 99, NFPA 101, associated IEEE standards, DOE regulations and Control Guidelines for Project Planning and Development.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

1. Relay Panels:

a. Use Blue Ridge lighting control panels with override capabilities.
   i) ***Blue Ridge Technologies***
   1800 Sandy Plains Industrial Parkway Suite 216
   Marietta, GA 30066
   (800) 241-9173
   www.brtint.com

b. Have 10% spare relays with a minimum of two.
c. Use panels with P1 communications protocol.

2. Graphics:

a. Match existing graphics layout.
b. Match existing color code for different lighting zones.

3. Switches:

a. Use low voltage override switches with on and off capabilities.
b. Use sentry switches for existing line voltage switches.

EXHIBIT E2: CONTROL SYSTEM DESIGN GUIDELINE

GENERAL NARRATIVE:

This guideline is presented for mechanical engineers and others to be used in the design and renovation of facilities for Multnomah County. Engineering design fees and construction budgets shall consider the costs associated with employing these requirements. Deviations may be made from these requirements as long as the result provides a safe, adequate, quality design and approval is obtained from Multnomah County Planning and Development Technical Planning Branch. See related sections elsewhere; Control Sequences Guidelines, Boiler Design Guidelines, Chiller Design Guidelines, and HVAC System Design Guidelines. County Master Specifications are also available for application of the Siemens DDC.

A. The following items should be addressed in all facilities whether leased or owned. Where practical apply the design parameters to existing systems to determine the extent of redesign necessary.

☐3. HVAC system controls are designed such that simultaneous heating and cooling, reheating, and re-cooling are minimized.

☐4. Individual zone temperature conditions during occupancy are maintained within a heating/cooling range (initial setpoints, 68F heating/75F cooling) Zone temperature heating/cooling setpoints incorporate a dead band of 5 F degrees. County policy provides that no mechanical heating shall occur to satisfy room temperatures over 70 degrees or that mechanical cooling occur to satisfy room temperatures below 75 degrees.

☐5. Avoid shutting off air completely to isolated offices and conference rooms in occupied areas unless provisions are made to use occupancy sensors tied to the operation of fans or dampers that will respond immediately to fluctuating occupancy levels.

☐6. Final location of all devices shall be approved by Facilities and Property Management, Operations and Maintenance Division.

☐7. Final approval of all programming prior to installation in panels shall be approved by Facilities and Property Management, Operations and Maintenance Division.

☐8. Site operator stations may be required. Final determination shall be by Facilities and Property Management, Operations and Maintenance Division. The project shall provide all necessary hardware and software for the workstation in a room which is well lit and has adequate power.

☐9. Adequate time for training shall be provided for all new systems. A rule of thumb is 10 minutes/point.

B. The following items should be addressed in all new and remodeled facilities that are owned by the County and might be applicable to long-lease facilities, where instructed by the County. Not applicable to residential buildings, which should be equipped with a 7-day programmable thermostat. For County-owned retail tenant spaces, refer to Project Manager for deviations from the guideline.

☐1. All central HVAC control systems shall be remotely adjustable from Facilities and Property Management main headquarters at 401 N. Dixon. No new pneumatic control systems are allowed.

C. The following items should be considered to determine what kind of control system to use on projects:

☐1. When the existing building operates using a Siemens system, all future controls in the building will be Siemens.

a. ***Siemens***
300 New Jersey Avenue
Suite 1000
Washington, D.C. 20001
(800) 743-6367
www.usa.siemens.com

☐2. All new large buildings with central air handling systems and hydronic systems distributed throughout the building shall use the most appropriate manufacture DDC Controls as determined by the mechanical engineer and Multnomah County Facilities Management.

D. Refer to County Master Control Specifications for programming requirements. The following items should be addressed in all facilities where a DDC system is specified:

☐1. Packaged air handling units that are controlled by internal controllers shall have a terminal strip or sensors available for industry standard BAS inputs and outputs including, as relevant to the unit:
a. Fan start/stop or enable/disable (EMS digital out, DO).
b. Fan proof of flow status (DI).
c. Filter status (DI).
d. Supply air temperature (AI).

☐2. All non-continuously operating air-handling systems with heating capability (in unit and/or at terminal units) shall have an optimal start /stop sequence.

☐3. Night purge, when available with the selected control system, shall be incorporated into the design.

☐4. All non-continuously operating fan systems shall have a night low limit sequence.

☐5. All non-continuously operating fan systems serving spaces whose temperatures might rise above 85 deg during unoccupied hours when the fans are not operating shall have a night high limit sequence, if available.

☐6. Economizer cooling shall be provided.

☐7. All heating, cooling, or heating and cooling air-handling systems that serve more than one zone shall be provided with discharge air temperature reset, if available.

☐8. All fan powered terminal boxes with reheat shall be equipped with discharge air temperature sensors.

☐9. All fan powered terminal boxes serving MIS, telecomm and electrical rooms shall have a DI point for operational status.

☐10. Humidification and dehumidification control shall only be provided for single zone systems or zone-based systems.

☐11. Each terminal equipment controller shall be served by it's own space and duct temperature sensor.

☐12. Identify areas that require HVAC occupant override. Generally, these are areas that will be subject to frequent after-hours operation or are temperature critical areas.

☐13. Provide freeze protection on all air handling systems with a maximum outside air percentage greater than 25% as well as all units with hydronic coils and outside air.

☐14. Smoke detection shall be provided per code, installed by the fire and life safety contractor.

E. The following items should be addressed for the specific type of HVAC system proposed. Refer to County Master Control Specifications for programming requirements:

☐1. The detailed location for each OSA temperature sensor shall be defined by the Designer and the one that will be used for algorithms and fan systems shall be identified.
   a. Large buildings where the OSAT is to be used as a global point for more than one algorithm shall have two (2) outdoor air temperature sensors.
   b. An OSA sensor will be installed in each panel using OSA temperature in algorithms for equipment control.

☐2. When boiler staging is controlled by packaged boiler controls, then all output signals and alarms from the packaged boiler controls shall be accessible to the DDC system. In this case, primary heating water (HW) pumps will be controlled directly by the boiler control unit or by the DDC system, as a function of the signals from the boiler control unit. The intent of this is that the boiler and primary HW pump controls be coordinated. When optimal stop is utilized, the pump is controlled by the DDC system.

☐3. Built-up air handling units (generally >75 tons) shall have the following minimum points:

a. Fan start/stop or enable/disable (DO).
b. Fan proof of flow status (DI).
c. Filter high differential pressure status (DI).
d. Heating (1 or more DOs or AO).
e. Cooling (1 or more DOs or AO).
f. Discharge air temperature (AI).
g. Mixed air temperature (AI).
h. OSA damper minimum enable (DO).
i. OSA damper modulation (DO).
j. Fire/smoke alarm (DI).
k. Supply air pressure setpoint or fan speed signal (AO) (VAV systems).

☐4. Minimum points required for control of VFDs on built-up air handling units are:
a. Start Stop (DO).
b. Fan Speed or Hertz (AO).
(1) Minimum flow condition when the fan is off, ramping up gradually to required flows.
c. Fan Proof (amperage) (AI).
d. Fault (DI).

☐5. VFD Supply fan volume shall be controlled to maintain the duct static pressure setpoint. High limit/low limit conditions will shut down fans and register an alarm. Static pressure control per County Master Specifications for Siemens. VFD shall utilize native P1 and P2 communication protocol.

☐6. VFD Return/Relief fan volume shall be controlled by building static pressure. Differential static pressure setpoint typically will be between 0.015" and 0.05" W.G. building static pressure control.

☐7. VFD Return/Relief fan volume shall be controlled by speed tracking.

☐8. If a Mechanical Contractor(s), under the Engineers direction, elects to use or is required to use packaged equipment with self-contained controls, it shall be the responsibility of the Control Contractor to coordinate interface of the DDC System with the Engineers or Mechanical Contractor's packaged equipment. This coordination shall be in advance of project bid date to insure compatibility and further insure cost of required equipment and software development is included in the Control Contractor's bid.

F. Graphic Requirements for DDC Projects.

1. The main page for the building should have the features listed:
a. Should have the County title bar with building name.
b. OSA temp.
c. All major equipment status and supply temp "AHU's, chillers, boilers, etc."
d. If there are more than one floor in building. A graphical side view of building with links for each floor.
e. All equipment shown should have a link to the page for that equipment. By clicking the mouse over the picture or the name of the equipment.
f. For chillers and boiler show supply and return temps and equipment alarms.

2. Graphics for each floor in a building should have the features listed:

a. The floor plan should be from the auto-cad drawing, if one is provided by M.C.
b. Room numbers should be on floor plan for each floor.
c. The floor should show locations of room sensors, and HVAC equipment.
d. The floor should be broke up with different color areas to show each HVAC zone.
e. The HVAC equipment like VAV boxes should show box name, room number, and space temp. The points that are show for each VAV …etc. should allow the user to drag and drop for the floor plan to the default graphic for that application number.
f. The points used for TEC room temps should be the sub-points not manually un-bundled points created by the staff or Siemens Building Technologies
g. Each floor drawing should have a way to go between floors with links.
h. Each floor should have a OSA temp point.
i. Each floor should have a link to the air handler that supplies that floor or area

3. All points that are alarmable should have a graphic associated with them. This will allow drag and drop feature from the alarm screen.

4. Graphics for major equipment should use “green” for “on” and “blue” for “off’. And all pumps, fans chillers, etc… should have some part of the drawing associated with the command point to show the state colors.

5. All graphics should have links to the main page for the building. And any needed links like “chiller page” also should have links to needed “pump pages” and “cooling towers.”

6. All graphics should have the County title bar at the top with building name and the background color be Micrographic designer color RGB 0 128 128.

G. Building Specifications for New Installations

1. All graphics shall meet the standards listed above “Graphic Requirements for DDC Projects”

2. All point meet new standard of building number then point. Example “B119.A02EE”

3. All TEC’s meet new standards for building number then TEC number, example “B119.01010”

4. All TEC point shall be the auto-unbundled points no manually unbundled points are allowed.

5. All default user accounts must be changes to County standard when site is connected to the server. This will be for County administrators use only. Each Contractor or user must have separate login at field panel.

6. All scheduling of equipment, start/stop and optimization will be done through Scheduler no PPCl calculations to control the Start/stop and Optimization.

7. All new county networks will have a BLN speed of 38,400 baud. Siemens Spec wire for install.

8. All TEC's shall have discharge air sensor installed on each box.

EXHIBIT E3: CONTROL SEQUENCE DESIGN GUIDELINE

GENERAL NARRATIVE:

All HVAC system controls shall be designed such that simultaneous heating and cooling, reheating, and re-cooling are minimized. This applies as well to non-mechanical treatment of mixed air (e.g. outside air, heat recovery, etc.) which must then be mechanically reheated or re-cooled.

A. General Controls

1. When several pieces of equipment (or different operational modes of one piece of equipment) must operate in an integrated way, they shall not be controlled from individual setpoints or by non-integrated controllers. For example, in a boiler plant, the heating water pumps and the boilers should be interlocked by either hardware or software, rather than enabling each by its own outside air setpoint.
2. Alarms: Except as directed otherwise by the County, all alarms will be registered at the building operator's terminal as well as at the Robert W. Blanchard Education Service Center (401 N. Dixon Street, Portland Oregon 97227-1865) remote operator's station. Alarms are to be registered with a message explaining the nature of the alarm and which building the alarm is in.
3. A minimum of two outdoor air temperature sensors shall be installed in any building where the outdoor air temperature is to be used as a global point for more than one algorithm. The designer will define the detailed location for each OSA temperature sensor, and will direct which sensor signal, or average, will be used for which algorithms and fan systems.
4. If microclimate conditions can be expected to affect various HVAC systems in the building differently, consider additional outdoor air temperature sensors at appropriate locations.
5. Whenever a setpoint is referred to as "adjustable" in these standards, the setpoint is to be easily and directly adjustable at the operator's terminal and Blanchard Building remote operator's station, and is not to require any code modification. In general, this will require assigning virtual points to all adjustable setpoints. Frequently adjusted points, including space temperature setpoints, shall be adjustable from the graphics screen.
6. Use averaging sensors for mixed air temperature, multi-zone hot and cold deck temperatures, and other situation where stratification of more than 2 F degrees across the duct section is likely. For multi-zone hot and cold deck temperatures, if spatial conditions do not permit use of an averaging sensor, use two single point sensors in different plenum locations, and average the two signals.
7. Programmable time-of-day (start/stop) control shall be implemented for all HVAC equipment, except for:
   a. Equipment that is interlocked with other equipment under direct start/stop control (e.g. exhaust fans interlocked with an air handling unit)
   b. Equipment that must run continuously for reasons of safety
   c. As otherwise noted in these standards

B. Air Handling Systems

1. ***Packaged Air Handling Unit EMS interfaces***
   a. If packaged air handling units are controlled by internal controllers, then the Designer will consider, with County input, the advisability of having all internal controller inputs and outputs accessible and controllable at the DDC system

operator's terminal and at the Blanchard Building remote operator's station via a gateway or similar interface. In general, such an interface may be advisable if the project has at least 3 air handling units with internal controllers, or if 2 or more such air handling units exceed 60 tons in combined total cooling capacity. Analysis shall consider energy, operation, maintenance, and installed interface equipment costs. BACnet communications according to ANSI/ASHRAE 135-2004 or ANSI/ASHRAE 135-2008. Native communication protocal must be Siemens Apogee P1 or P2. Communication Drivers and Gateways are not allowed.

b. If the Designer determines that the expense of a gateway is not warranted, air handling units with internal controllers shall have a terminal strip available for industry standard EMS inputs and outputs including:
   (1) AHU start/stop (DO)
   (2) occupied/unoccupied mode (BO)
   (3) occupied/unoccupied mode (DI)
   (4) zone cooling setpoint (AO)
   (5) zone heating setpoint (AO)
   (6) supply air pressure setpoint (AO)
   (7) dirty filter (DI)
   (8) supply fan failure (DI)
   (9) refrigeration failure (DI)
   (10) heating failure (DI)

c. The Designer shall ensure that any control sequences that are not standard to the internally controlled packaged air handling unit will be achievable with the points that are available to the EMS.

2. ***Supply Fan Volume Control (Variable Air Volume Systems)***

a. This section applies to supply fans that are modulated by variable frequency drives (VFD), inlet vanes, variable pitch blades or vanes, inlet cones, and other such fan control devices.

b. With all modes of control, the fan control devices shall move to the minimum flow condition when the fan is off, and shall ramp up gradually to required flows.

c. Duct static pressure high limit control is required in all systems where a potential for over-pressurization of ductwork exists. High limit condition will shut down fan and register an alarm.

d. Select one of the following modes of control:
   (1) Static Pressure Control: Supply fan volume is controlled to maintain the duct static pressure at setpoint, as sensed at a static pressure sensor(s) located at 75% to 100% of the distance from the first to the most remote terminal. Static pressure setpoint shall be determined by the air test and balance agency such that at that static pressure the damper serving the zone with the greatest cooling load is between 90% and 98% open at the same time that the majority of other zones are under a moderate to heavy cooling load (a load roughly equal in magnitude to the design building cooling diversity).
      (a) Static pressure reset should also be considered for large fan systems. This involves resetting the duct static pressure setpoint as a function of duct velocity.
      (b) The duct static pressure shall be the average of the values from two sensors located close together. If the differential between the two sensors is greater than 0.3", an alarm will be registered.
   (2) Control as Function of Damper Position: Supply fan volume is controlled such that the primary air damper serving the zone with the greatest

cooling load is 95% open. Note that, though this sequence theoretically gives very efficient fan control, in practice it may be very difficult to tune to avoid excessive fan and damper hunting.

3. ***Return / Relief Fan Volume Control (Variable Volume Systems)***
   a. This section applies to return and relief fans with variable frequency drives (VFD), inlet vanes, variable pitch blades or vanes, inlet cones, and so forth.
   b. With all modes of control, the fan control devices shall move to the minimum flow condition when the fan is off, and shall ramp up gradually to required flows.
   c. All building spaces shall be at a positive pressure relative to the outside. In addition, there may be requirements for pressurization of spaces relative to each other.
   d. Select one of the following modes of control:
      (1) Building Static Pressure Control: Return or relief fan volume is controlled such that the static pressure of a reference space (typical zone or zone of greatest occupancy) is maintained at a certain setpoint relative to outside air. Differential static pressure setpoint typically will be between 0.015" and 0.05" W.G. (initial setpoint, 0.02"). The location of the indoor measurement shall be remote from doors and openings to the outside, away from elevator lobbies, and shielded from air velocity effects. The outdoor measurement location should be 10 to 15 feet above the building and oriented to minimize wind effects from all directions. During warm-up mode, the building static pressure is reset to zero, and all relief and exhaust fans shall be off.
      (2) Airflow Tracking: A constant CFM or % differential is maintained between the supply and return air streams. Flow stations in the two streams, consisting of multi-point averaging pitot arrays, provide the input for this control. During warm-up mode, the return airflow is reset equal to the supply airflow, and all relief and exhaust fans shall be off.

C. Fan Enable / Optimal Start Control

1. All non-continuously operating air handling systems with heating capability (in unit and/or at terminal units) shall have this sequence.
2. The intent of this sequence is that the air handling system be started early enough that, at maximum fan speed and maximum heating output, all spaces served reach occupied heating setpoint no more than 30 minutes prior to or 10 minutes after scheduled occupancy.
3. Air handling systems may be started under the optimal start mode no more than 3 hours prior to scheduled occupancy.
4. Air handling systems will be started as a function of outdoor air temperature, greatest negative differential between space temperature and occupied heating setpoint, calculated maximum rate of space temperature rise, and time until start of scheduled occupancy. This sequence will be locked out when the 3 hour rolling average outdoor air temperature is greater than setpoint (initial setpoint, 50°F, adjustable).
5. The calculated rate of space temperature rise will be modified each day when the optimal start mode ends such that the next day's rate of rise is increased or decreased as a function of by how much earlier than 30 minutes prior to scheduled occupancy or later than 10 minutes after scheduled occupancy all spaces reached occupied heating setpoint.
6. The controls contractor will initialize and fine tune the optimal start algorithm as required to meet the operational intent.

7. When the system is in optimal start mode, the mixed air dampers will be in full recirculation and the supply volume (for variable volume systems) will be limited to the return volume. Mechanical cooling is disabled, except as stages subsequent to economizer cooling if required to lower space temperature to occupied cooling setpoint.
8. When the return air temperature is greater than the occupied heating setpoint (initial setpoint, 68°F, adjustable), the optimal start mode will end and occupied mode will start.
9. In addition, a more complex sequence for optimal start of cooling equipment should be considered for buildings with significant cooling energy expenditure. Such a sequence must be "adaptive" or "anticipatory" (i.e. be self-tuning, based on previous 1 to 2 days building response), and should optimize economizer operation, mixed air temperature, and chilled water plant startup. This sequence should be locked out when the 3 hour rolling average outdoor air temperature during the scheduled unoccupied mode is less than setpoint (initial setpoint, 50°F, adjustable).
10. The building operator will be able to command start of occupancy at the operator's terminal and at the Blanchard Building remote operator's station (overriding the optimal start sequence) for each individual air handling system and globally for all air handling systems in the building. All points in operator priority will register as alarms.

D. Night Purge

1. This is a relatively complex control mode in which building spaces are cooled down by outside air. This sequence should be considered for buildings with large internal loads, in which a significant portion of the building mass is in thermal contact with the air stream, and in which mechanical cooling would be typically required within the first several hours of occupancy during the cooling season.
2. This mode will be enabled when the average space temperature during the unoccupied mode is above the occupied cooling setpoint, and the outside air temperature is greater than setpoint (initial setpoint, 40°F, adjustable), and the outside air temperature is at least 10 F degrees (adjustable) less than the average space temperature, and the time is within 3 hours (adjustable) of scheduled occupancy.
3. The interior space night purge setpoint (temperature to which the space will be cooled by night purge) will be adjustable, set initially to the midpoint of the heating/cooling deadband. No space shall be cooled below a temperature at which heating will be required, either in the occupied or warm-up modes.
4. When this mode is enabled, the mixed air dampers modulate to maintain the mixed air temperature at setpoint (initial setpoint, 50°F, adjustable). Heating and mechanical cooling are disabled.
5. If the fans that serve the purged spaces are equipped with VFD (or other means of volume control), the speed should be reduced in this mode to the speed that provides the optimal balance between fan electrical consumption and adequate heat transfer between the building mass and the air stream. The Designer will provide the initial setpoints for night purge fan speeds.

E. Night Low Limit

1. All non-continuously operating fan systems shall have this sequence.
2. Single zone systems: During the unoccupied mode, when the space temperature falls below the low limit (initial setpoint, 60°F, adjustable), the system supply and return fans will start, outside air and exhaust dampers will be closed, and heating

will stage on as required to maintain the discharge air temperature at setpoint until the space is raised above setpoint plus differential. If heating stages are controlled as a function of discharge air temperature setpoint, the setpoint shall be reset up during this mode.

3. Multiple zone systems: During the unoccupied mode, when any space temperature falls below the low limit setpoint, the system supply and return fans will start, outside air and exhaust dampers will be closed, and heating will stage on as required to maintain the discharge air temperature at setpoint until all spaces are raised above setpoint plus differential.
4. Warming of spaces that are below setpoint may be accomplished by terminal unit or zone reheat coils instead of by a raised discharge air temperature, but the AHU discharge air temperature setpoint shall not be lower than the return air temperature during this mode. If warming of spaces that are below setpoint is to be accomplished by terminal unit reheat coils, it is preferable that the terminal unit primary air dampers be placed in reverse acting mode during night low limit operation.
5. When all spaces served by the system are above setpoint plus differential (initial setpoints, 60°F adjustable, with 5 F degree differential), the system will revert to the unoccupied mode.

F. Night High Limit

1. All non-continuously operating fan systems serving spaces whose temperatures might rise above 85°F during hours when the fans are not operating shall have this sequence.
2. Mechanical cooling is enabled as the final stage(s) of cooling during this sequence if the space temperatures are not less than the respective occupied setpoints plus differential one hour (adjustable) prior to scheduled occupancy.
3. Single zone systems: During the unoccupied mode, if the space temperature rises above the high limit (initial setpoint, 85°F, adjustable), and if the outdoor air temperature is less than the space high limit setpoint, the system supply and return fans will start, the outside air, return, and exhaust dampers will modulate to maintain the mixed air temperature at setpoint (initial setpoint, 55°F, adjustable), and mechanical cooling will stage on until the space temperature is lowered below setpoint minus differential. (See above requirements for mechanical cooling during night high limit mode.)
4. Multiple zone systems: During the unoccupied mode, when any space temperature rises above the high limit setpoint (initial setpoint, 85°F, adjustable), the system supply and return fans will start, the outside air, return, and exhaust dampers will modulate to maintain the mixed air temperature at setpoint (initial setpoint, 55°F, adjustable), and mechanical cooling will stage on until the out-of-limit space temperature(s) is lowered below setpoint minus differential. (See above requirements for mechanical cooling during night high limit mode.)
5. When all spaces served by the system are below setpoint minus differential (initial setpoints, 85°F adjustable, with 5 F degree differential), the system will revert to the unoccupied mode.

G. Economizers (Air-side)

1. All air handling units that cool by mechanical cooling shall be equipped with air-side economizers, with exceptions as allowed by the Oregon Energy Conservation Code. Economizer operation shall be integrated with mechanical cooling (i.e. able to share load with mechanical cooling) except as allowed by code.
2. Outside air dampers will remain closed when the air handling unit supply fan is off. During normal occupied operation and during night high limit operation, if there is a call for cooling from any served zone and if the outside air temperature is less than the return air temperature, the outside air, return air, and exhaust air dampers modulate as a coordinated set to maintain the mixed air temperature at setpoint.
3. If the outside air temperature is greater than the return air temperature, the outside air damper will go to minimum position, as required for ventilation. Designer shall communicate to controls contractor required minimum position for each air handling unit, as well as minimum primary air damper position for VAV terminal units.
4. For single zone systems, the mixed air temperature setpoint will be fixed (initial setpoint, 55°F, adjustable, or per packaged unit manufacturer).
5. For variable volume, multi-zone, dual duct, and other multiple zone systems, the mixed air temperature setpoint will be reset as a function of the highest zone cooling load. If no zone has a cooling load, and at least one zone has a heating load, the mixed air temperature setpoint will be reset up to a maximum (initial setpoint, 65°F, adjustable). The highest zone cooling load will be determined by the DDC system highest zone cooling signal, position of the most open primary air damper, position of the most open zone cooling coil valve, or similar indicator of true load. Zone temperature is not an indicator of true load, by itself.

H. Discharge Air Temperature Reset

1. A variation of this sequence will be used for all heating, cooling, or heating and cooling air handling systems that serve more than one zone.
2. Single Duct Variable Air Volume Systems:
   a. The discharge air temperature will be reset as an average of the cooling loads of representative and critical zones. The designer, controls contractor, and test and balance contractor will coordinate to identify terminal units from representative and critical (but not “wild”) building zones. For each system, at least 4 such terminal units (or all, whichever is less) should be identified.
   b. Zone cooling load will be determined by the DDC system zone cooling signal, positive deviation of space temperature above setpoint, position of the primary air damper, position of the zone cooling coil valve, or similar indicator of true load. Zone temperature is not an indicator of true load, by itself.
   c. If there are “wild” zones, i.e. zones that almost always require full primary air flow, the design and test and balance for these zones should be reconsidered.
   d. The minimum value of the discharge air temperature reset will be initially set to between 50 and 55°F at a maximum average sample zone cooling signal (average of the selected representative / critical zones). The maximum value will be initially set to between 65 and 70°F at a zero average sample zone cooling signal.
   e. Systems that serve zones with dissimilar cooling and heating loads, and that have terminal units with no means of zonal reheat (e.g. variable volume / variable temperature systems) are generally not acceptable.

3. **Dual Duct and Multizone Systems**:
   a. For chiller plants greater than 500 tons total capacity, designer will analyze whether optimization of the total of the chiller power and CHW-supplied fan system power is warranted. In general, if the fan system power is less than 25% of the chiller power, optimization sequences are not required and the following sequences will be used.
   b. The cold deck temperature will be reset as an average of the cooling loads of representative and critical zones. The designer, controls contractor, and test and balance contractor will coordinate to identify representative and critical (but not “wild”) building zones. For each system, at least 4 such zones (or all, whichever is less) should be identified. It is also acceptable, and in some cases (where there is one or more critical zones) preferable, to use a single highest critical zone cooling load instead of an average of sample zone cooling loads.
   c. Zone cooling load will be determined by the DDC system zone cooling signal, positive deviation of space temperature above setpoint, position of zone cold deck damper, or similar indicator of true load. Zone temperature is not an indicator of true load, by itself.
   d. If there are “wild” zones, i.e. zones that almost always require full cold deck flow, the design and test and balance for these zones should be reconsidered.
   e. The minimum value of the cold deck temperature reset will be initially set to between 50 and 55°F at a maximum average sample zone cooling signal (average of the selected representative / critical zones). The maximum value will be initially set to between 65 and 70°F at a zero average sample zone cooling signal.
   f. The hot deck temperature will be reset as an average of the heating loads of representative and critical zones. The designer, controls contractor, and test and balance contractor will coordinate to identify representative and critical (but not “wild”) building zones. For each system, at least 4 such zones (or all, whichever is less) should be identified. It is also acceptable, and in some cases (where there is one or more critical zones) preferable, to use a single highest critical zone heating load instead of an average of sample zone heating loads.
   g. The maximum value of the hot deck temperature reset will be initially set to between 95 and 110°F at a maximum average sample zone heating signal (average of the selected representative / critical zones). The minimum value will be initially set to between 65 and 75°F at a zero sample zone heating signal.
   h. For systems with a neutral deck, the neutral deck temperature will be reset according to the economizer sequence for multiple zone systems.
4. **Humidity Control**:
   a. This section does not apply to the uncontrolled dehumidification that may result from temperature-controlled cooling.
   b. Humidification and dehumidification equipment and sequences will be applied only in cases where equipment or processes require controlled relative humidities (e.g. computer rooms, certain medical occupancies, laboratories) and in cases where internal loads may cause unsatisfactory conditions (e.g. swimming pools).
   c. Humidification will be achieved downstream of any cooling coils.
   d. If direct evaporative cooling is used, it will be controlled such that it does not result in a requirement for mechanical cooling dehumidification. Outdoor dew

point temperature and space dew point temperature setpoint may be used for this control.

e. Humidification and dehumidification should generally not be applied in systems that serve multiple zones with widely varying humidity requirements. Single zone systems or zone based humidifiers should be considered in these cases.
f. Humidification and dehumidification equipment will be interlocked with the air handling systems supplying the respective zones.
g. Humidifier output will be modulated to maintain the zone humidistat or humidity sensor above setpoint ± differential. A duct high limit sensor will limit duct relative humidity to less than 90% (adjustable).
h. Heat recovery should be considered for systems with significant dehumidification requirements.

5. **Zone Control**:

a. Individual zone temperature conditions during occupancy will be maintained within a heating/cooling range (initial setpoints, 68°F heating / 73°F cooling, unless otherwise instructed by County). Zone temperature heating/cooling setpoints will incorporate a deadband of 5 F degrees, unless otherwise instructed by County. Setpoints will be easily adjustable at both the operator's terminal and at the Blanchard Building remote operator's station.
b. Room sensors will not be adjustable by occupants and will not have temperature displays, unless the Designer is directed otherwise by the County.
c. Each and every terminal equipment controller (TEC) shall be served by its own space temperature sensor. All TEC points shall be accessible at the space sensor via a portable terminal or notebook computer.
d. **Single Duct VAV Systems**:
   (1) Acceptable VAV terminal unit types include: throttling, series fan-powered, and parallel fan-powered. Any of the VAV terminal unit types may be supplied with or without reheat coils.
   (2) During the scheduled unoccupied mode, primary air dampers will be closed.
   (3) During warm-up, if the air handling system is equipped with a non-electric heating source and the reheat coils are electric, primary air dampers will be in reverse-action mode to maximize heating by the non-electric heating source.
   (4) During scheduled occupancy and night high or low limit operation, primary air dampers will modulate between a minimum position for no cooling to full open for a maximum cooling signal, to maintain the zone below the cooling setpoint. Upon a call for heating, the primary air dampers will modulate to the heating position and terminal unit fans and heating coils (where relevant) will sequence on to maintain the zone above the heating setpoint.
   (5) Minimum primary air damper position will be determined by the designer and will be the volume required for ventilation per ASHRAE Standard 62-1989.
   (6) Reheat primary air damper position will be determined by the designer and will be no larger than the largest of: 1) 30% of the maximum position, 2) the volume required for ventilation per current ASHRAE Standard, or 3) 0.4 CFM/ft^2.
e. **Dual Duct VAV Systems**:
   (1) During scheduled occupancy and night high limit operation, if there is a cooling load the cold deck damper will modulate between a minimum

position for no cooling to full open for a maximum cooling signal, to maintain the zone below the cooling setpoint. The hot deck damper will be fully closed in this condition.

(2) Upon a call for heating, the hot deck damper will modulate between a minimum position for no heating to full open for a maximum heating signal, to maintain the zone above the heating setpoint. The cold deck damper will be fully closed in this condition.

6. **Occupant Override**:
   a. The Designer shall, with input from the County, identify those zones that require HVAC occupant override due to frequent or critical after-hours occupancy. The Designer shall also define the initial override time period for each such zone.
   b. For systems that are to be provided with occupant override control, each normally occupied zone shall be equipped with an occupant override button located at the zone temperature sensor. If available, an LED on the sensor shall indicate when the system is in override mode.
   c. When the air handling unit is in the unoccupied mode, pushing the override button will place the air handling unit, and terminal units served by sensors whose overrides have been pushed, in the occupied mode for the programmed duration (initial setpoint, 60 minutes, adjustable, with a maximum setpoint limit of 4 hours). At the end of the override period, the system will revert to the scheduled mode in effect at that time.
7. **System Safeties**:
   a. **Freeze Protection**:
      (1) This sequence is required for all air handling units with maximum outside air percentages greater than 25% as well as all units with hydronic coils and any provision for outside air.
      (2) The freeze stat shall utilize an averaging element type sensor where any 12 inch (or less) element that senses a temperature below setpoint causes actuation of the freeze protection mode. The sensor is typically to be located downstream of the heating coil, though dual duct systems and dehumidification / reheat systems may prompt other arrangements. If there is a cooling coil upstream of a heating coil, locate the freeze stat at the cooling coil.
      (3) When the air stream temperature falls below the freeze protection setpoint (initial setpoint, 38°F, adjustable), all fans in the air handling unit will stop, the mixing dampers go to the full recirculation position, all hydronic coil valves go to full coil flow, and an alarm will be registered. The freeze stat shall require manual reset before air handling unit operation can resume.

b. **Smoke Detection**:
   (1) Smoke detectors will be located in the supply and return duct sections as required by code. Smoke detectors will be installed by the fire and life safety contractor.
   (2) Smoke detectors will cause shutdown of their respective fans upon detection of smoke, and an alarm will be registered at the operator's terminal.
   (3) The system will return to normal operation when the alarm is cleared at the operator's terminal or fire panel.

c. **High / Low Static Pressure Shutdown**:
   (1) All air handling units with downstream dampers (upstream dampers for return duct), including fire dampers, and capable of generating static pressures in excess of the rated duct construction allowance at zero flow will be equipped with static pressure sensors.
   (2) For variable volume air handling units, when the discharge duct static pressure sensor senses a static pressure more than 1" greater than the design static pressure (or 75% of the rated duct pressure if that is less than design static plus 1"), the supply fan volume control will be overridden to limit the static pressure to the rated duct pressure. Similarly, when the return duct static pressure sensor senses a static pressure more than 1" less than the rated duct negative pressure, the return fan volume control will be overridden to limit the static pressure to the rated duct pressure.
   (3) When the discharge duct or return duct static pressure exceeds the respective rated duct pressure for more than 5 seconds, the supply and return fans will be shut down, and an alarm will be registered. The high limit will require manual reset before operation can resume. The low limit (return duct) will require operator alarm acknowledgment before operation can resume.

d. **High Air Filter Pressure Drop**:
   (1) For all air handling units with filters and air volumes greater than 5000 CFM, a differential pressure switch located across each filter bank will register an alarm at the operator's terminal whenever the differential pressure exceeds setpoint (initial setpoint, 0.5", or as recommended by filter manufacturer, adjustable).
   (2) Facilities will calibrate differential pressure switch.
   (3) Alarm is reset by operator at terminal.

I. Chilled Water System Control:

2. **EMS interfaces**. (Note that relevant information in this interface section must be included in the specification section for chillers.)
   a. If chillers are controlled by internal controllers, then the Designer will consider, with County input, the advisability of having all internal controller inputs and outputs accessible and controllable at the DDC system operator's terminal and at the Blanchard Building remote operator's station via a gateway or similar interface. In general, such an interface will be advisable if the project has at least 100 tons of chiller capacity. Analysis shall consider energy, operation, maintenance, and installed interface equipment costs.
   b. If the Designer determines that the expense of a gateway is not warranted, each chiller shall have a terminal strip available for industry standard EMS inputs and outputs including:

(1) Chiller start/stop (EMS binary out)
(2) Chilled water supply setpoint (AO)
(3) Chiller failure (BI)

3. **Chiller Water System Start/Stop Control**:
   a. All chilled water system equipment shall be off during times when all served units are scheduled as unoccupied, unless any system is in the Night High Limit mode and mechanical cooling is required per the Night High Limit sequence.
   b. When any unit served by the chilled water system is on and is calling for cooling, and when the outside air temperature is above setpoint (initial setpoint, 55°F, adjustable), a time counter is started. After 15 minutes (adjustable) of both conditions being true, the lead primary chilled water pump(s), the lead secondary chilled water pump(s) if applicable, and the lead condenser water pump(s) are started. Absence of any of these conditions for 15 minutes will cause all chilled water system pumps to be turned off.
   c. When pump flow is proven, and any 2 cooling coils are open to 50% or greater, the lead chiller is started.
   d. When the chilled water return temperature (primary, common header, as applicable) is less than the chilled water supply temperature (primary loop, common header) plus the set differential (initial setpoint, 3 F degrees, adjustable) for 5 minutes, the lead chiller is turned off. Minimum chiller run-time shall be per manufacturer's requirements.
   e. Cooling tower is enabled when the lead chiller is on. Select the lead tower optimally for the lead chiller.
4. **Chilled Water Reset**:
   a. **Primary Chilled Water Systems**:
      (1) Primary chilled water supply temperature will be reset as a function of the cooling load. The designer, controls contractor, and test and balance contractor will coordinate to identify chilled water valves from representative and critical (but not "wild") building zones and fan systems. At least 4 such valves (or all chilled water valves, whichever is less) should be identified.
      (2) If there are "wild" zones, i.e. zones that almost always require full chilled water flow, the design and test and balance for these zones should be reconsidered.
      (3) On startup of the chiller, the initial chilled water supply temperature setpoint will be the midpoint between the upper and lower reset limits.
      (4) If none of the representative/critical valves are fully open, the chilled water supply temperature (CHWST) is reset upwards by increments with time delays between adjustments to allow for system stabilization. The increments and time delays must be tuned for the specific system, though 2 F degree increments at 10 minute intervals can be used as initial settings.
      (5) If one of the representative/critical valves is fully open, no resetting is done.
      (6) If two or more of the representative/critical valves are fully open, the CHWST is reset downward by increments with time delays between adjustments.
      (7) **Optional methods of reset**:
         (a) As a function of chilled water supply and return temperature differential.
         (b) The reset table upper and lower limits will be a function of system characteristics. The designer will recommend a reset schedule. The

upper reset limit should be as high as possible, while meeting cooling loads. In general, for chilled water coils in fan systems with discharge air temperature reset, the upper reset limit should be approximately 12-15 F degrees (design differential between the coil entering chilled water temperature and the coil leaving air temperature, plus 3 to 5 F degrees) less than the lowest upper DAT reset limit of all served fan systems. Example: If the coil design is for 44°F entering CHW and 55°F leaving air temperatures (design differential of 11 F degrees), and if there are 3 fan systems with discharge air temperature reset as high as 63°F, 65°F, and 65°F respectively, then the upper reset limit for the CHW would be 63°F - 11 F degrees - 3 F degrees = 49°F. The lower reset limit would be 44°F.

b. **Primary/Secondary Chilled Water Systems**:
   (1) For chiller plants greater than 500 tons total capacity, designer will analyze whether optimization of the total of the chiller and secondary pump power is warranted. In general, if the secondary pump power is less than 15% of the chiller power, optimization sequences are not required.
   (2) For chiller plants less than 500 tons total capacity or for any chiller plant in which the secondary pump power is less than 15% of the chiller power, the primary chilled water temperature can be reset in the same way as with primary-only chilled water systems, as a strict function of cooling load.

5. **Chiller Staging / Capacity Control**:
   a. Multiple chillers, and their respective primary chilled water and condenser water pumps, will be staged on as a time function of the secondary loop flow, where applicable. (See secondary chilled water pump speed control for criteria on when secondary pumping systems are recommended. Most multiple chiller and even most single chiller systems will have variable volume secondary pumps.) In general, chillers are to be staged on when the secondary loop flow exceeds 95% of the rated evaporator flow of the previously staged chiller for 5 minutes. Each chiller is to be staged off when the secondary loop flow is less than 90% of the rated evaporator flow of the previously staged chiller for 5 minutes. Minimum chiller run-time shall be per manufacturer's requirements.
   b. Control of chiller staging by power input, leaving chilled water temperature, or reverse flow in the secondary loop bypass are not acceptable.
   c. For chiller plants greater than 500 tons in total capacity, designers will perform an analysis to ensure that chillers will be staged on such that, insofar as possible, chillers will run at their points of maximum efficiency. With many manufacturers, this will be at 50% load or less. Thus, it may be appropriate to stage on a second chiller when the first chiller is only operating at 50% load, then stage on a third chiller, then increase the loading on each chiller, and so forth. Differences in full load and part load efficiencies among the different chillers shall also be considered. Pump and tower energy consumption must also be considered in this analysis.

6. **Tower Staging / Capacity Control**:
   a. Tower stages (dampers, spray pumps, fan speeds, multiple towers, as applicable) will be sequentially staged on and off to maintain the common header tower leaving water temperature (ECWT) at the greater of minimum setpoint or ambient wet bulb temperature plus tower design approach.
      (1) The minimum setpoint will correspond to the chiller manufacturer's minimum allowable condensing water temperature.

(2) The ambient wet bulb temperature may be determined either with a wet bulb sensor or with a combination of dry bulb and relative humidity sensors, using software psychrometric calculations.

b. When the lead tower is operating at minimum capacity, a tower bypass valve will modulate as required to maintain the common header tower leaving water temperature above the minimum setpoint, but below the minimum setpoint plus differential (initial setpoint, 2 F degrees, adjustable).
c. During freezing weather, when the tower is on, the bypass valve will be operated as a two-position valve.

7. **Lead / Lag Control**:
   a. If the chiller plant includes two or more chillers of unequal operating efficiencies, the most efficient chiller for the given conditions will normally be selected as the lead.
   b. The operator can command any chiller, tower, and pumps to the lead and subsequent lag positions.
   c. Under automatic control, the DDC system will determine the lead and subsequent lag chillers and towers based on totalized run time of any unit over the setpoint number of hours (initial setpoint, 100 hours, adjustable) more than any other unit.
   d. For primary and secondary pumps, the DDC system will register an alarm at the operator's terminal when the respective lead pump has a totalized run time more than the setpoint number of hours (initial setpoint, 4000 hours, adjustable) more than the lag pump(s). Switching lead and lag pumps will be manual only.
8. **Secondary Chilled Water Pump Speed Control**:
   a. The designer shall consider secondary chilled water pumping systems for all situations where the total chiller plant capacity is greater than 50 tons, where any cooling coils are not close to the chiller, and where there is sufficient load diversity that the chiller plant can be expected to operate at less than 80% capacity more than 25% of the time.
   b. All secondary pumps shall be of identical capacity and head. Each such pump shall be controlled by an individual VFD. When 2 or more secondary pumps are running, they shall run at the same speed (within ±1% of each other).
   c. With or without secondary pumps, evaporator flow shall be constant unless otherwise approved by the chiller manufacturer.
   d. Static pressure sensing for secondary pump speed control will be by end-of-run differential pressure.
   e. The lead secondary pump speed will be modulated between minimum speed (initial setpoint, 20%, adjustable, or minimum acceptable to motor manufacturer) and an upper staging limit (adjustable), to maintain the end-of-run differential pressure at setpoint. The upper staging limit is to be selected by the engineer for optimum system wire-to-water efficiency. Generally, this setpoint will be between 50% and 70% speed, depending on pump capacities, number of secondary pumps, system head characteristic, etc.
   f. The differential pressure setpoint will be determined by the test and balance agency such that the 2-way valve serving the cooling coil with the greatest load is between 90% and 98% open at the same time that the majority of other cooling coils are under a moderate to heavy cooling load (a load roughly equal in magnitude to the design building cooling diversity).
   g. If the lead pump is operating at greater than the upper staging setpoint for at least 5 minutes, and the end-of-run differential pressure is below the setpoint minus an adjustable differential (initial differential, 2 psi), then the lag pump

shall be started and its speed ramped up. Both pumps will run at the same speed, as required to maintain the end-of-run differential pressure at setpoint.

h. The lag pump is turned off when the end-of-run differential pressure is above the setpoint plus an adjustable differential (initial differential, 1 psi) for more than 1 minutes, and both pumps are running at less than the upper staging setpoint speed.
i. If the differential pressure is above setpoint plus 2 psi for more than 1 minute, and only the lead pump is running, and the lead pump is running at minimum speed, then the secondary loop bypass valve will modulate to maintain the differential pressure at setpoint.

J. Heating Water System Control:

1. **General**:
   a. If the boiler staging is controlled by packaged boiler controls, then all input and output signals and alarms from the packaged boiler controls shall be accessible to the DDC system. In this case, primary heating water (HW) pumps will be controlled directly by the boiler control unit or by the DDC system, as a function of the signals from the boiler control unit. The intent of this is that the boiler and primary HW pump controls be coordinated.
   b. Secondary HW pumps shall be considered for any heating water system in which the boilers are not rated by the manufacturer to accept the expected extremes of HW flow, should 2-way coil valves be used. In this application, an end-of-line bypass and control valve is required.
2. **Heating Water System Start/Stop Control**:
   a. When any equipment served by the heating water system is on and is (a) calling for heating, or (b) when the outside air temperature is below setpoint (initial setpoint, 50°F, adjustable), a time counter is started. After 10 minutes (adjustable) of either condition being true, the lead secondary heating water pump if applicable, and then the lead primary heating water pump (or boiler circulation pump) are started. When boiler flow is proven, the lead boiler is started.
   b. Absence of both of the above start conditions for 10 minutes (adjustable) will cause all heating water system pumps and boilers to be turned off.
   c. When the heating water return temperature (primary, common header, as applicable) is greater than the heating water supply temperature (primary loop, common header) minus the set differential (initial setpoint, 3 F degrees, adjustable) for 5 minutes, the lead boiler is turned off. If the OSA temperature is less than setpoint at this time, the pumps remain on. If the OSA temperature is greater than setpoint, after a time delay of 5 minutes, the lead primary and secondary HW pumps are turned off.
3. **Heating Water Temperature Reset**:
   a. **General**: The leaving boiler water temperature (primary heating water supply temperature -- PHWST) will be reset as a function of the highest heating load of selected representative / critical zones. The highest heating load will be determined by the EMS highest zone heating load signal, position of the most open heating coil valve, or similar indicator of true load. Zone temperature by itself is not an indicator of true load. The minimum boiler vessel temperature will be set at 140°F for non-condensing boilers.
   b. **The designer**, controls contractor, and test and balance contractor will coordinate to identify heating water valves from representative and critical (but not “wild”) building zones and fan systems. At least 4 such valves from each of fan systems and zonal reheat coils (or all heating water valves, whichever is less) should be identified.

c. On startup of the boiler, the initial PHWST setpoint will be the midpoint between the upper and lower reset limits.
d. If none of the representative/critical valves are fully open, the PHWST is reset downwards by increments with time delays between adjustments to allow for system stabilization. The increments and time delays must be tuned for the specific system, though 5 F degree increments at 10 minute intervals can be used as initial settings.
e. If one of the representative/critical valves is fully open, no resetting is done.
f. If two or more of the representative/critical valves are fully open, the PHWST is reset upwards by increments with time delays between adjustments.
g. The reset table upper and lower limits will be a function of system characteristics. The designer will recommend a reset schedule. The lower reset limit should be as low as possible, while meeting heating loads, and subject to the 140°F minimum non-condensing boiler vessel temperature . The upper limit should be no higher than required for coil design loads.

4. **Boiler Staging / Capacity Control**:
   a. **Multiple boilers**, and their respective primary heating water pumps, will be staged on as a time function of the secondary loop flow, or variable primary loop flow, as applicable. (See secondary heating water pump speed control for criteria on when secondary pumping systems are recommended.) In general, boilers are to be staged on when the flow exceeds 95% of the rated maximum flow of the previously staged boiler for 5 minutes. Each boiler is to be staged off when the flow is less than 90% of the rated maximum flow of the previously staged boiler for 5 minutes.
   b. **Optional sequences** for boiler staging are to use a time function of either the differential between the heating water supply and return temperatures, or simply the differential between the return temperature and setpoint.
5. **Lead / Lag Control**:
   a. If the boiler plant includes two or more boilers of unequal operating efficiencies, the most efficient boiler for the given conditions will normally be selected as the lead.
   b. The operator can command any boiler or pump to the lead and subsequent lag positions.
   c. Under automatic control, the DDC system or packaged boiler controls will determine the lead and subsequent lag boilers based on totalized run time of any unit over the setpoint number of hours (initial setpoint, 100 hours, adjustable) more than any other unit.
   d. For primary and secondary pumps, the DDC system will register an alarm at the operator's terminal when the respective lead pump has a totalized run time more than the setpoint number of hours (initial setpoint, 4000 hours, adjustable) more than the lag pump(s). Switching lead and lag pumps will be manual only.
6. **Secondary Heating Water Pump (and Variable Flow Primary Pump) Speed Control**:
   a. The designer shall consider secondary heating water pumping systems for any heating water system in which the boilers are not rated by the manufacturer to accept the expected extremes of HW flow, and where the design HW flow is greater than 200 gpm.
   b. With or without secondary pumps, boiler flow shall be constant unless otherwise approved by the boiler manufacturer.
   c. All secondary pumps shall be of identical capacity and head. Each such pump shall be controlled by an individual VFD. When 2 or more secondary pumps are running, they shall run at the speed (within ±1% of each other).

d. Static pressure sensing for pump speed control will be by end-of-run differential pressure.
e. The lead secondary pump speed will be modulated between minimum speed (initial setpoint, 20%, adjustable, or minimum acceptable to motor manufacturer) and an upper staging limit (adjustable), to maintain the end-of-run differential pressure at setpoint. The upper staging limit is to be selected by the engineer for optimum system wire-to-water efficiency. Generally, this setpoint will be between 50% and 70% speed, depending on pump capacities, number of secondary pumps, system head characteristic, etc.
f. The differential pressure setpoint will be determined by the test and balance agency such that the 2-way valve serving the heating coil with the greatest load is between 90% and 98% open at the same time that the majority of other heating coils are under a moderate to heavy heating load.
g. If the lead pump is operating at greater than the upper staging setpoint for at least 5 minutes, and the end-of-run differential pressure is below the setpoint minus an adjustable differential (initial differential, 2 psi), then the lag pump shall be started and its speed ramped up. Both pumps will run at the same speed, as required to maintain the end-of-run differential pressure at setpoint.
h. The lag pump is turned off when the end-of-run differential pressure is above the setpoint plus an adjustable differential (initial differential, 1 psi) for more than 1 minutes, and both pumps are running at less than the upper staging setpoint speed.
i. If the differential pressure is above setpoint plus 2 psi for more than 1 minute, and only the lead pump is running, and the lead pump is running at minimum speed, then the secondary loop bypass valve will modulate to maintain the differential pressure at setpoint.