



Regional Private Sewer Lateral Program

Compliance Certificate for Private Sewer Lateral

Parcel Address: **1918 M L KING JR WAY, OAKLAND** Certificate Number: **57548**
Parcel Number: **003 -0041-008-00** Issue Date: **08/20/2019**
Expiration Date: **08/20/2039** Type: **Compliance: replaced lateral**

Special Instructions:

Retain this PSL certificate for your records for any future parcel sale, re-model greater than \$100,000, or change of water meter size.

This certificate was issued solely on the basis of the performance of the tested sewer lateral in a verification test performed in the presence of EBMUD personnel. The verification test is designed for the sole purpose of determining whether the tested portion of a sewer lateral is free from leaks at the time the test is performed. By issuing this certificate, EBMUD warrants only that the tested portion of the sewer lateral passed a verification test on the date indicated. EBMUD makes no warranty, representation, or guarantee as to the sewer laterals existing or future condition or its compliance with the legal standards of any other jurisdiction, including building or construction standards without limitation. EBMUD expressly disclaims any and all warranties, both express and implied, as to the sewer laterals condition or compliance with legal standards and shall bear no liability in connection therewith.

ORDER NO. : 1117025998

The land referred to is situated in the County of Alameda, City of Oakland, State of California, and is described as follows:

A portion of Lots 19, 20 and 21, Block A, Grove Tract Redivided, filed May 1, 1877 in [Book 3, Page 31](#), of Maps, Alameda County Records, described as follows:

Beginning at a point on the Southeastern line of Martin Luther King, Jr. Way, formerly Grove Street, distant thereon Northeasterly 80 feet from the intersection thereof with the Northeastern line of 19th Street, formerly Curve Street, thence Southeasterly parallel with said line of 19th Street 90 feet to the Southeastern boundary line of said Lot 19; thence Northeasterly parallel with said line of Martin Luther King, Jr. Way to the Eastern boundary line of said Lot 21; thence Northerly along said boundary line to the Northeastern boundary line of said Lot 21; thence Northwesterly along said Northeastern boundary line 86.65 feet to the said line of Martin Luther King, Jr. Way-, thence Southwesterly along said line of Martin Luther King, Jr. Way, 51 feet to the point of beginning.

Assessor's Parcel No: [003-0041-008-00](#)



OLD REPUBLIC
TITLE COMPANY

555 12th Street, Suite 2000
Oakland, CA 94607
(510) 272-1121 Fax: (510) 208-5045

PRELIMINARY REPORT

COUNTY OF ALAMEDA
1401 Lakeside Drive, 9th Fl.
94612, CA

Attention: RACHEL CAFARELLI

1st update

Our Order Number 1117025998-JM

When Replying Please Contact:

Julie Massey
JMassey@ortc.com
(510) 272-1121

Property Address:

1918 Martin Luther King Jr Way, Oakland, CA 94561

In response to the above referenced application for a policy of title insurance, OLD REPUBLIC TITLE COMPANY, as issuing Agent of Old Republic National Title Insurance Company, hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said policy forms.

The printed Exceptions and Exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit I attached. The policy to be issued may contain an arbitration clause. When the Amount of Insurance is less than that set forth in the arbitration clause, all arbitrable matters shall be arbitrated at the option of either the Company or the Insured as the exclusive remedy of the parties. Limitations on Covered Risks applicable to the Homeowner's Policy of Title Insurance which establish a Deductible Amount and a Maximum Dollar Limit of Liability for certain coverages are also set forth in Exhibit I. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit I of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.

It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects, and encumbrances affecting title to the land.

This report (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance, a Binder or Commitment should be requested.

Dated as of June 15, 2023, at 7:30 AM

OLD REPUBLIC TITLE COMPANY
For Exceptions Shown or Referred to, See Attached

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ORDER NO. 1117025998-JM
1st update

The form of policy of title insurance contemplated by this report is:

CLTA Standard Coverage Owner's Policy of Title Insurance - 2022; AND ALTA Loan Policy of Title Insurance - 2021. A specific request should be made if another form or additional coverage is desired.

The estate or interest in the land hereinafter described or referred or covered by this Report is:

Fee

Title to said estate or interest at the date hereof is vested in:

1918 MLK OZ, LLC, a California limited liability company

The land referred to in this Report is situated in the County of Alameda, City of Oakland, State of California, and is described as follows:

A portion of Lots 19, 20 and 21, Block A, Grove Tract Redivided, filed May 1, 1877 in [Book 3, Page 31](#), of Maps, Alameda County Records, described as follows:

Beginning at a point on the Southeastern line of Martin Luther King, Jr. Way, formerly Grove Street, distant thereon Northeasterly 80 feet from the intersection thereof with the Northeastern line of 19th Street, formerly Curve Street, thence Southeasterly parallel with said line of 19th Street 90 feet to the Southeastern boundary line of said Lot 19; thence Northeasterly parallel with said line of Martin Luther King, Jr. Way to the Eastern boundary line of said Lot 21; thence Northerly along said boundary line to the Northeastern boundary line of said Lot 21; thence Northwesterly along said Northeastern boundary line 86.65 feet to the said line of Martin Luther King, Jr. Way-, thence Southwesterly along said line of Martin Luther King, Jr. Way, 51 feet to the point of beginning.

Assessor's Parcel No: [003-0041-008-00](#)

At the date hereof exceptions to coverage in addition to the Exceptions and Exclusions in said policy form would be as follows:

1. Taxes and assessments, general and special, for the fiscal year 2023 - 2024, a lien, but not yet due or payable.

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2. Taxes and assessments, general and special, for the fiscal year 2022 - 2023, as follows:

Assessor's Parcel No	:	003 -0041-008	
Bill No.	:	014284-00	
Code No.	:	17-022	
1st Installment	:	\$11,786.03	Marked Paid
2nd Installment	:	\$11,786.03	Marked Paid
Land Value	:	\$964,971.00	
Imp. Value	:	\$573,621.00	
P.P. Value	:	\$25,958.00	

3. The lien of supplemental taxes, if any, assessed pursuant to the provisions of Section 75, et seq., of the Revenue and Taxation Code of the State of California.

4. An assessment of the Oakland Vacant Property Tax, whether or not shown as existing liens by the records of the City of Oakland.

NOTE: Further information may be obtained by contacting the Oakland Vacant Property Tax administrator toll free at (855) 831-1188.

5. The herein described property lying within the proposed boundaries of a Community Facilities District, as follows:

District No	:	2014-1
For	:	Clean Energy
Disclosed By	:	Assessment Map Book 18 Page 65
Recorded	:	August 24, 2015 in Official Records under Recorder's Serial Number 2015235594

Further information may be obtained by contacting:
Ygrene Fund Energy Inc
www.gsfahome.org

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6. Any special tax which is now a lien and that may be levied within the CFD A/C-3, a notice of which was recorded as follows:

Instrument Entitled : Notice of Special Tax Lien
By : EBRPD
Recorded : [January 31, 2019 in Official Records under Recorder's Serial Number 201915593](#)

NOTE: Among other things, there are provisions in said Notice for a special tax to be levied annually, the amounts of which are to be added to and collected with the property taxes.

NOTE: The current annual amount levied against this land is \$5.44.

Further information may be obtained by contacting:

Name : East Bay Regional Park District

7. Redevelopment Plan, as follows:

Entitled : Central District Redevelopment Project
Executed By : Redevelopment Agency of the City of Oakland
Recorded : [December 3, 2007 in Official Records under Recorder's Serial Number 2007409569](#)

And any amendments thereto.

8. Prior to the issuance of any policy of title insurance, the Company requires the following with respect to 1918 MLK OZ, LLC, a California Limited Liability Company:

1. A copy of any management or operating agreements and any amendments thereto, together with a current list of all members of said LLC.
2. A certified copy of its Articles of Organization (LLC-1), any Certificate of Correction (LLC-11), Certificate of Amendment (LLC-2), or Restatement of Articles of Organization (LLC-10).
3. Recording a Certified copy of said LLC-1 and any "amendments thereto".

9. Any facts, rights, interests, or claims that are not shown by the Public Records but that could be ascertained by an inspection of the Land or that may be asserted by persons in possession of the Land.

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10. Any unrecorded and subsisting leases.
11. The requirement that this Company be provided with a suitable Owner's Declaration (form ORT 174). The Company reserves the right to make additional exceptions and/or requirements upon review of the Owner's Declaration.
12. The requirement that this Company be provided with an opportunity to inspect the land (the Company reserves the right to make additional exceptions and/or requirements upon completion of its inspection).
13. Any claim of lien for services, labor or material arising from an improvement or work under construction or completed at the date hereof.

----- **Informational Notes** -----

- A. The applicable rate(s) for the policy(s) being offered by this report or commitment appears to be section(s) 1.1 & 2.1.
- B. The above numbered report (including any supplements or amendments thereto) is hereby modified and/or supplemented to reflect the following additional items relating to the issuance of an American Land Title Association loan form policy:

NONE

NOTE: Our investigation has been completed and there is located on said land a commercial building known as 1918 Martin Luther King Junior Way, Oakland, CA 94612.

The ALTA loan policy, when issued, will contain the CLTA 100 Endorsement and 116 series Endorsement.

Unless shown elsewhere in the body of this report, there appear of record no transfers or agreements to transfer the land described herein within the last three years prior to the date hereof, except as follows:

Grant Deed executed by Normand A. Groleau and Michelle L Groleau, Trustees of the Groleau Family Trust dated November 22, 1996 to 1918 MLK OZ, LLC, a California limited liability company recorded [March 18, 2021 in Official Records under Recorder's Serial Number 2021111383](#).

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C. We find no open Deeds of Trust. A written statement must be provided by the current owner(s) attesting to whether any outstanding Deeds of Trust exist.

D. June 22, 2023 The above 1st Updated Preliminary Report, has been modified for the following :

- x Taxes
- x Plant Date
- x Policy type

sp

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NOTE:

The following statement is deemed attached as a coversheet to any declaration, governing document, or deed identified in the above exceptions:

If this document contains any restriction based on age, race, color, religion, sex, gender, gender identity, gender expression, sexual orientation, familial status, marital status, disability, veteran or military status, genetic information, national origin, source of income as defined in subdivision (p) of Section 12955, or ancestry, that restriction violates state and federal fair housing laws and is void, and may be removed pursuant to Section 12956.2 of the Government Code by submitting a "Restrictive Covenant Modification" form, together with a copy of the attached document with the unlawful provision redacted to the county recorder's office. The "Restrictive Covenant Modification" form can be obtained from the county recorder's office and may be available on its internet website. The form may also be available from the party that provided you with this document. Lawful restrictions under state and federal law on the age of occupants in senior housing or housing for older persons shall not be construed as restrictions based on familial status.

Information for processing a "Restrictive Covenant Modification" form:

1. Print a complete copy of the document in question. Strike out what you believe to be unlawful restrictive language in the document.
2. Print and complete the "Restrictive Covenant Modification" ("RCM") form. Note that the signature on the form must be acknowledged by a notary public or other qualified officer.
3. Submit the completed RCM form and the document with your strike-outs to the County Clerk-Recorder's Office for the county where the property is located. No fee is required for this service.
4. The County Clerk-Recorder's Office will forward the RCM form and the document with your strike-outs to the Office of the County Counsel, who will determine whether the document contains any unlawful restrictions.
5. The Office of the County Counsel will return the RCM form and the document with your strike-outs to the County Clerk-Recorder's Office along with its determination. If approved, a Deputy County Counsel will sign the RCM, and the County Clerk-Recorder's Office will record, image and index it. If the Office of the County Counsel determines that the document does not contain an unlawful restriction, the County Clerk-Recorder's Office will not record the RCM.
6. The approved RCM will be returned to the submitter by mail.

The "Restrictive Covenant Modification" form is linked below:

[Restrictive Covenant Modification form](#)

Exhibit I

**CALIFORNIA LAND TITLE ASSOCIATION
STANDARD COVERAGE OWNER'S POLICY OF TITLE INSURANCE – 2022**

EXCLUSIONS FROM COVERAGE

The following matters are excluded from the coverage of this policy, and the Company will not pay loss or damage, costs, attorneys' fees, or expenses that arise by reason of:

1. a. any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) that restricts, regulates, prohibits, or relates to:
 - i. the occupancy, use, or enjoyment of the Land;
 - ii. the character, dimensions, or location of any improvement on the Land;
 - iii. the subdivision of land; or
 - iv. environmental remediation or protection.
- b. any governmental forfeiture, police, regulatory, or national security power.
- c. the effect of a violation or enforcement of any matter excluded under Exclusion 1.a. or 1.b.
Exclusion 1 does not modify or limit the coverage provided under Covered Risk 5 or 6.
2. Any power of eminent domain. Exclusion 2 does not modify or limit the coverage provided under Covered Risk 7.
3. Any defect, lien, encumbrance, adverse claim, or other matter:
 - a. created, suffered, assumed, or agreed to by the Insured Claimant;
 - b. not Known to the Company, not recorded in the Public Records at the Date of Policy, but Known to the Insured Claimant and not disclosed in writing to the Company by the Insured Claimant prior to the date the Insured Claimant became an Insured under this policy;
 - c. resulting in no loss or damage to the Insured Claimant;
 - d. attaching or created subsequent to the Date of Policy (Exclusion 3.d. does not modify or limit the coverage provided under Covered Risk 9 or 10); or
 - e. resulting in loss or damage that would not have been sustained if consideration sufficient to qualify the Insured named in Schedule A as a bona fide purchaser had been given for the Title at the Date of Policy.
4. Any claim, by reason of the operation of federal bankruptcy, state insolvency, or similar creditors' rights law, that the transaction vesting the Title as shown in Schedule A is a:
 - a. fraudulent conveyance or fraudulent transfer;
 - b. voidable transfer under the Uniform Voidable Transactions Act; or
 - c. preferential transfer:
 - i. to the extent the instrument of transfer vesting the Title as shown in Schedule A is not a transfer made as a contemporaneous exchange for new value; or
 - ii. for any other reason not stated in Covered Risk 9.b.
5. Any claim of a PACA-PSA Trust. Exclusion 5 does not modify or limit the coverage provided under Covered Risk 8.
6. Any lien on the Title for real estate taxes or assessments imposed or collected by a governmental authority that becomes due and payable after the Date of Policy. Exclusion 6 does not modify or limit the coverage provided under Covered Risk 2.b.
7. Any discrepancy in the quantity of the area, square footage, or acreage of the Land or of any improvement to the Land.

EXCEPTIONS FROM COVERAGE

Some historical land records contain Discriminatory Covenants that are illegal and unenforceable by law. This policy treats any Discriminatory Covenant in a document referenced in Schedule B as if each Discriminatory Covenant is redacted, repudiated, removed, and not republished or recirculated. Only the remaining provisions of the document are excepted from coverage.

This policy does not insure against loss or damage and the Company will not pay costs, attorneys' fees, or expenses resulting from the terms and conditions of any lease or easement identified in Schedule A, and the following matters:

PART I

1. (a) Taxes or assessments that are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the Public Records; (b) proceedings by a public agency that may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the Public Records.

2. Any facts, rights, interests, or claims that are not shown by the Public Records at Date of Policy but that could be (a) ascertained by an inspection of the Land, or (b) asserted by persons or parties in possession of the Land.
3. Easements, liens or encumbrances, or claims thereof, not shown by the Public Records at Date of Policy.
4. Any encroachment, encumbrance, violation, variation, easement, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and not shown by the Public Records at Date of Policy.
5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b), or (c) are shown by the Public Records.
6. Any lien or right to a lien for services, labor, material or equipment unless such lien is shown by the Public Records at Date of Policy.
7. Any claim to (a) ownership of or rights to minerals and similar substances, including but not limited to ores, metals, coal, lignite, oil, gas, uranium, clay, rock, sand, and gravel located in, on, or under the Land or produced from the Land, whether such ownership or rights arise by lease, grant, exception, conveyance, reservation, or otherwise; and (b) any rights, privileges, immunities, rights of way, and easements associated therewith or appurtenant thereto, whether or not the interests or rights excepted in (a) or (b) appear in the Public Records or are shown in Schedule B.

PART II

(Variable exceptions such as taxes, easements, CC&R's, etc., are inserted here)

Exhibit I

**AMERICAN LAND TITLE ASSOCIATION
LOAN POLICY OF TITLE INSURANCE – 2021**

EXCLUSIONS FROM COVERAGE

The following matters are excluded from the coverage of this policy, and the Company will not pay loss or damage, costs, attorneys' fees, or expenses that arise by reason of:

1. a. any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) that restricts, regulates, prohibits, or relates to:
 - i. the occupancy, use, or enjoyment of the Land;
 - ii. the character, dimensions, or location of any improvement on the Land;
 - iii. the subdivision of land; or
 - iv. environmental remediation or protection.
- b. any governmental forfeiture, police, regulatory, or national security power.
- c. the effect of a violation or enforcement of any matter excluded under Exclusion 1.a. or 1.b.
Exclusion 1 does not modify or limit the coverage provided under Covered Risk 5 or 6.
2. Any power of eminent domain. Exclusion 2 does not modify or limit the coverage provided under Covered Risk 7.
3. Any defect, lien, encumbrance, adverse claim, or other matter:
 - a. created, suffered, assumed, or agreed to by the Insured Claimant;
 - b. not Known to the Company, not recorded in the Public Records at the Date of Policy, but Known to the Insured Claimant and not disclosed in writing to the Company by the Insured Claimant prior to the date the Insured Claimant became an Insured under this policy;
 - c. resulting in no loss or damage to the Insured Claimant;
 - d. attaching or created subsequent to the Date of Policy (Exclusion 3.d. does not modify or limit the coverage provided under Covered Risk 11, 13, or 14); or
 - e. resulting in loss or damage that would not have been sustained if consideration sufficient to qualify the Insured named in Schedule A as a bona fide purchaser or encumbrancer had been given for the Insured Mortgage at the Date of Policy.
4. Unenforceability of the lien of the Insured Mortgage because of the inability or failure of an Insured to comply with applicable doing-business law.
5. Invalidity or unenforceability of the lien of the Insured Mortgage that arises out of the transaction evidenced by the Insured Mortgage and is based upon usury law or Consumer Protection Law.
6. Any claim, by reason of the operation of federal bankruptcy, state insolvency, or similar creditors' rights law, that the transaction creating the lien of the Insured Mortgage is a:
 - a. fraudulent conveyance or fraudulent transfer;
 - b. voidable transfer under the Uniform Voidable Transactions Act; or
 - c. preferential transfer:
 - i. to the extent the Insured Mortgage is not a transfer made as a contemporaneous exchange for new value; or
 - ii. for any other reason not stated in Covered Risk 13.b.
7. Any claim of a PACA-PSA Trust. Exclusion 7 does not modify or limit the coverage provided under Covered Risk 8.
8. Any lien on the Title for real estate taxes or assessments imposed by a governmental authority and created or attaching between the Date of Policy and the date of recording of the Insured Mortgage in the Public Records. Exclusion 8 does not modify or limit the coverage provided under Covered Risk 2.b. or 11.b.
9. Any discrepancy in the quantity of the area, square footage, or acreage of the Land or of any improvement to the Land.

EXCEPTIONS FROM COVERAGE

Some historical land records contain Discriminatory Covenants that are illegal and unenforceable by law. This policy treats any Discriminatory Covenant in a document referenced in Schedule B as if each Discriminatory Covenant is redacted, repudiated, removed, and not republished or recirculated. Only the remaining provisions of the document are excepted from coverage.

This policy does not insure against loss or damage and the Company will not pay costs, attorneys' fees, or expenses resulting from the terms and conditions of any lease or easement identified in Schedule A, and the following matters:

NOTE: The 2021 ALTA Loan Policy may be issued to afford either Standard Coverage or Extended Coverage. In addition to variable exceptions such as taxes, easements, CC&R's, etc., the Exceptions from Coverage in a Standard Coverage policy will also include the Western Regional Standard Coverage Exceptions listed as 1 through 7 below:

1. (a) Taxes or assessments that are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the Public Records; (b) proceedings by a public agency that may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the Public Records.
2. Any facts, rights, interests, or claims that are not shown by the Public Records at Date of Policy but that could be (a) ascertained by an inspection of the Land, or (b) asserted by persons or parties in possession of the Land.
3. Easements, liens or encumbrances, or claims thereof, not shown by the Public Records at Date of Policy.
4. Any encroachment, encumbrance, violation, variation, easement, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and not shown by the Public Records at Date of Policy.
5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b), or (c) are shown by the Public Records.
6. Any lien or right to a lien for services, labor, material or equipment unless such lien is shown by the Public Records at Date of Policy.
7. Any claim to (a) ownership of or rights to minerals and similar substances, including but not limited to ores, metals, coal, lignite, oil, gas, uranium, clay, rock, sand, and gravel located in, on, or under the Land or produced from the Land, whether such ownership or rights arise by lease, grant, exception, conveyance, reservation, or otherwise; and (b) any rights, privileges, immunities, rights of way, and easements associated therewith or appurtenant thereto, whether or not the interests or rights excepted in (a) or (b) appear in the Public Records or are shown in Schedule B.

Updated 1/1/2023



FACTS	WHAT DOES OLD REPUBLIC TITLE DO WITH YOUR PERSONAL INFORMATION?
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Why?	Financial companies choose how they share your personal information. Federal law gives consumers the right to limit some but not all sharing. Federal law also requires us to tell you how we collect, share, and protect your personal information. Please read this notice carefully to understand what we do.
What?	<p>The types of personal information we collect and share depend on the product or service you have with us. This information can include:</p> <ul style="list-style-type: none"> • Social Security number and employment information • Mortgage rates and payments and account balances • Checking account information and wire transfer instructions <p>When you are no longer our customer, we continue to share your information as described in this notice.</p>
How?	All financial companies need to share customers' personal information to run their everyday business. In the section below, we list the reasons financial companies can share their customers' personal information; the reasons Old Republic Title chooses to share; and whether you can limit this sharing.

Reasons we can share your personal information	Does Old Republic Title share?	Can you limit this sharing?
For our everyday business purposes — such as to process your transactions, maintain your account(s), or respond to court orders and legal investigations, or report to credit bureaus	Yes	No
For our marketing purposes — to offer our products and services to you	No	We don't share
For joint marketing with other financial companies	No	We don't share
For our affiliates' everyday business purposes — information about your transactions and experiences	Yes	No
For our affiliates' everyday business purposes — information about your creditworthiness	No	We don't share
For our affiliates to market to you	No	We don't share
For non-affiliates to market to you	No	We don't share

	Go to www.oldrepublictitle.com (Contact Us)
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Who we are	
Who is providing this notice?	Companies with an Old Republic Title name and other affiliates. Please see below for a list of affiliates.

What we do

How does Old Republic Title protect my personal information?	To protect your personal information from unauthorized access and use, we use security measures that comply with federal law. These measures include computer safeguards and secured files and buildings. For more information, visit https://www.oldrepublictitle.com/privacy-policy
How does Old Republic Title collect my personal information?	<p>We collect your personal information, for example, when you:</p> <ul style="list-style-type: none"> • Give us your contact information or show your driver's license • Show your government-issued ID or provide your mortgage information • Make a wire transfer <p>We also collect your personal information from others, such as credit bureaus, affiliates, or other companies.</p>
Why can't I limit all sharing?	<p>Federal law gives you the right to limit only:</p> <ul style="list-style-type: none"> • Sharing for affiliates' everyday business purposes - information about your creditworthiness • Affiliates from using your information to market to you • Sharing for non-affiliates to market to you <p>State laws and individual companies may give you additional rights to limit sharing. See the State Privacy Rights section location at https://www.oldrepublictitle.com/privacy-policy for your rights under state law.</p>

Definitions

Affiliates	<p>Companies related by common ownership or control. They can be financial and nonfinancial companies.</p> <ul style="list-style-type: none"> • Our affiliates include companies with an Old Republic Title name, and financial companies such as Attorneys' Title Fund Services, LLC, Lex Terrae National Title Services, Inc., and Mississippi Valley Title Services Company
Non-affiliates	<p>Companies not related by common ownership or control. They can be financial and non-financial companies.</p> <ul style="list-style-type: none"> • Old Republic Title does not share with non-affiliates so they can market to you
Joint marketing	<p>A formal agreement between non-affiliated financial companies that together market financial products or services to you.</p> <ul style="list-style-type: none"> • Old Republic Title doesn't jointly market.

Affiliates Who May be Delivering This Notice				
American First Title & Trust Company	American Guaranty Title Insurance Company	Attorneys' Title Fund Services, LLC	Compass Abstract, Inc.	eRecording Partners Network, LLC
Genesis Abstract, LLC	Guardian Consumer Services, Inc.	iMarc, Inc.	L.T. Service Corp.	Lenders Inspection Company
Lex Terrae National Title Services, Inc.	Lex Terrae, Ltd.	Mississippi Valley Title Services Company	National Title Agent's Services Company	Old Republic Branch Information Services, Inc.
Old Republic Diversified Services, Inc.	Old Republic Escrow of Vancouver, Inc.	Old Republic Exchange Company	Old Republic National Ancillary Services, Inc.	Old Republic Title and Escrow of Hawaii, Ltd.
Old Republic National Title Insurance Company	Old Republic Title Company	Old Republic Title Companies, Inc.	Old Republic Title Company of Conroe	Old Republic Title Company of Indiana
Old Republic Title Company of Nevada	Old Republic Title Company of Oklahoma	Old Republic Title Company of Oregon	Old Republic Title Company of St. Louis	Old Republic Title Company of Tennessee
Old Republic Title Information Concepts	Old Republic Title Insurance Agency, Inc.	Old Republic Title, Ltd.	RamQuest Software, Inc.	Republic Abstract & Settlement, LLC
Sentry Abstract Company	Surety Title Agency, Inc.	Trident Land Transfer Company, LLC		

Updated: January 1, 2023 v2

Privacy Notice for California Consumers

This Privacy Notice for California Consumers supplements the information contained in the Master Privacy Notice for Old Republic Title and applies to consumers that reside in the State of California. The terms used in this Privacy Notice have the same meaning as the terms defined in the California Consumer Privacy Act (“CCPA”).

What Personal Information We Collect

In accordance with the CCPA, personal information is information that identifies, relates to, describes, is capable of being associated with, or could reasonably be linked, directly or indirectly, with a particular consumer or household. Personal information does not include:

Information outside the scope of the CCPA such as:

- Health or medical information covered by the Health Insurance Portability Act of 1996 (HIPAA) and the California Confidentiality of Medical Information Act (CMIA).
- Personal Information covered by the Gramm-Leach-Bliley Act (GLBA), the Fair Credit Reporting Act (FCRA), the California Financial Information Privacy Act (FIPA), and the Driver’s Privacy Protection Act of 1994,
- Publicly available information or lawfully obtained, truthful information that is a matter of public concern, and
- De-identified or aggregated consumer information.

Please see the chart below to learn what categories of personal information we may have collected about California consumers within the preceding twelve months, the sources of and business purposes for that collection and the third parties to whom the information has been disclosed, if any.

Category	Examples	Sources	Business Purpose for Collection	Categories of Third Parties with Whom Information is Shared
Identifiers	Real name, alias, postal address, unique personal identifier, online	Consumers, Lenders, Brokers, Attorneys, Real Estate Agents, and	Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or	Service providers associated with the transaction for a business

	<p>identifier, Internet protocol address, email address, account name, social security number, driver's license number, passport number or other similar identifiers</p> <p>Social security number, driver's license number, passport number are collected</p>	<p>Title Agents associated with the transaction</p>	<p>complaints, detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal activity. Other audit or operational purposes.</p>	<p>purpose</p>
<p>Personal information described in California Customer Records statute (Cal. Civ. Code § 1798.80(e))</p>	<p>Name, signature, social security number, physical characteristics or description, address, telephone number, passport number, driver's license or state identification card number, insurance policy number, education, employment, employment history, bank account number, credit card number, debit card</p>	<p>Consumers, Lenders, Brokers, Attorneys, Real Estate Agents, and Title Agents associated with the transaction</p>	<p>Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or complaints, detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal activity. Other audit or operational purposes.</p>	<p>Service providers associated with the transaction for a business purpose</p>

	<p>number, or any other financial information, medical information, or health insurance information. "Personal information" does not include publicly available information that is lawfully made available to the general public from federal, state, or local government records.</p> <p>Social security number, driver's license number or state identification card number, passport number, bank account number are collected</p>			
<p>Characteristics of protected classifications under California or federal law</p>	<p>Age (40 years or older), race, color, ancestry, national origin, citizenship, religions or creed, marital status, medical condition, physical or</p>	<p>Consumers, Lenders, Brokers, Attorneys, Real Estate Agents, and Title Agents associated with the</p>	<p>Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or complaints. Other audit or operational purposes.</p>	<p>Service providers associated with the transaction for a business purpose</p>

	<p>mental disability, sex (including gender, gender identity, gender expression, pregnancy or childbirth and related medical conditions), sexual orientation, veteran or military status, or genetic information (including familial genetic information).</p> <p>Marital status, sex, physical disability, is collected</p>	transaction		
Internet or other electronic network activity	Browsing history, search history, information about a consumer's interaction with a website, application, or advertisement.	Consumers, Lenders, Brokers, Attorneys, Real Estate Agents, and Title Agents associated with the transaction	To provide access to certain online services. To understand the interests of visitors to our online services, to support certain features of our site, for navigation and to display certain features more effectively. Detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal	Not Disclosed

			activity. Other audit or operational purposes.	
--	--	--	--	--

What Personal Information We Disclose and Why We Disclose It

The CCPA requires us to tell you what categories of personal information we “sell”, “share” or “disclose.” We do not sell and will not sell your personal information as that term is commonly understood. We also do not sell and will not sell your personal information, including the personal information of persons under 16 years of age, as that term is defined by the CCPA. We do not share your personal information as that term is defined in the CCPA. When it is necessary for a business purpose, we may disclose your personal information with a service provider or contractor, and we enter into a contract with the service provider or contractor that limits how the information may be used and requires the service provider to protect the confidentiality of the information.

In the preceding twelve months, we have disclosed the following categories of personal information for the following business purposes. Where the personal information is shared with third parties, as that term is defined in the CCPA, the category of the third party is indicated.

Category	Examples	Business Purpose for Disclosure	Categories of Third Parties with Whom Information is Shared
Identifiers (Including social security number, driver’s license number, and passport	Real name, alias, postal address, unique personal identifier, online identifier, internet protocol address, email address, account name, social security number, driver’s license number, passport number or other similar identifiers	Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or complaints, detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal activity. Other audit or	Service providers associated with the transaction for a business purpose

number)		operational purposes.	
<p>Personal information described in California Customer Records statute (Cal. Civ. Code § 1798.80(e))</p> <p>(Including Social security number, driver's license number or state identification card number, passport number, and bank account number)</p>	<p>Name, signature, social security number, physical characteristics or description, address, telephone number, passport number, driver's license or state identification card number, insurance policy number, education, employment, employment history, bank account number, credit card number, debit card number, or any other financial information, medical information, or health insurance information.</p> <p>"Personal information" does not include publicly available information that is lawfully made available to the general public from federal, state, or local government records.</p>	<p>Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or complaints, detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal activity. Other audit or operational purposes.</p>	<p>Service providers associated with the transaction for a business purpose</p>
<p>Characteristics of protected classifications under California or federal law</p> <p>(Including marital status, sex, and physical disability)</p>	<p>Age (40 years or older), race, color, ancestry, national origin, citizenship, religions or creed, marital status, medical condition, physical or mental disability, sex (including gender, gender identity, gender expression, pregnancy or childbirth and related medical conditions), sexual orientation, veteran or military status, or genetic information (including familial genetic information).</p>	<p>Underwriting or providing other products or services, responding to policyholder/consumer claims, inquiries or complaints. Other audit or operational purposes.</p>	<p>Service providers associated with the transaction for a business purpose</p>
<p>Internet or other electronic network activity</p>	<p>Browsing history, search history, information about a consumer's interaction with a website, application, or advertisement.</p>	<p>To provide access to certain online services. To understand the interests of visitors to our online services, to support certain features of our site, for navigation and to</p>	<p>Not Disclosed</p>

		display certain features more effectively. Detecting security incidents, protecting against malicious, deceptive, fraudulent, or illegal activity. Other audit or operational purposes.	
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We may also transfer to a third party the personal information of a consumer as an asset that is part of a merger, acquisition, bankruptcy, or other transaction in which the third party assumes control of all or part of the business.

Our Retention of Your Personal Information

The length of time that we retain personal information largely depends upon the purpose for which the information was collected rather than the category of the information as set forth in this Notice. When establishing retention periods, we consider applicable statutes of limitation and legal and regulatory requirements and guidelines. Personal information is generally retained for periods of time that permit the company to meet its legal and regulatory obligations.

Your Rights and Choices

The CCPA provides California consumers with certain rights regarding their personal information. This chart describes those rights and certain limitations to those rights.

Right	What This Means
Notice	At or before the time your personal information is collected, you will be given written notice of the categories of personal information to be collected, the purposes for which the categories of personal information will be used, and whether that information is sold or shared.
Access	At your verifiable request, but no more than twice in a twelve month period, we shall disclose to you: 1) the categories of personal information we have collected about you, 2) the categories of sources for the personal information we collected about you, 3) our business or commercial purpose for collecting, selling or sharing your personal information, 4) the categories of third parties to whom we disclose your personal information, 5) the specific pieces of information we have collected about you, 6) the categories of personal information disclosed about you for a business purpose and the categories of persons to whom your personal information was disclosed for a business purpose, and 7) if we sold or shared personal information, the categories of personal information sold or shared and the categories of third parties to whom it was sold or shared.
Deletion	You have the right to request that we delete any of your personal information that we collected from you, subject to certain exceptions. Once we receive and

Non-Discrimination	We will not discriminate against you for exercising your rights under the CCPA. Unless otherwise permitted by the CCPA we will not: <ul style="list-style-type: none">• Deny you goods or service• Charge you different prices or rates for goods or services, including through granting discounts or other benefits, or imposing penalties• Provide a different level or quality of goods or services• Suggest that you will receive a different price or rate for goods or services or a different level or quality of goods or services
--------------------	--

To Exercise Your Rights

To Opt-out of the Sale or Sharing of Your Personal Information

The CCPA gives consumers the right to direct a business that sells or shares personal information about the consumer to third parties not to sell or share the consumer's personal information. We do not sell and will not sell your personal information as that term is commonly understood. We also do not sell and will not sell your personal information, as that term is defined by the CCPA. We do not share your personal information as that term is defined in the CCPA.

To Limit the Use of Sensitive Personal Information

The CCPA gives consumers the right to direct a business to limit the use of the consumer's sensitive personal information to that use which is necessary to perform the services or provide the goods reasonably expected by an average consumer who requests those goods or services and certain other limited uses as described in the CCPA and applicable regulations. We do not use or disclose sensitive personal information for purposes other than those purposes specified in Section 7027, subsection (m) of the California Consumer Privacy Act Regulations. If we begin using or disclosing your sensitive personal information outside of those purposes, then we will provide you with the option to limit our use or disclosure through a clear and conspicuous link on our internet homepage.

To Request Access to, Correction or Deletion of Your Personal Information

To exercise your access, correction or deletion rights described above, please submit a verifiable consumer request to us by either: Calling us at 1-855-557-8437 or contacting us through our website <https://ccpa.oldrepublictitle.com>.

Only you or your representative that you authorize to act on your behalf (Authorized Agent) can make a verifiable consumer request for your personal information. You may also make a request for your minor child. The verifiable request must provide enough information that allows us to reasonably verify you are the person about whom we collected personal information. We cannot respond to your request or provide you with personal information if we cannot verify your identity or authority to make the request and to confirm the personal information relates to you.

We work to respond to a verifiable consumer request within 45 days of its receipt. If we require additional time, we will inform you of the extension period (up to an additional 45 days), and the reason for the extension in writing. If you have an account with us, we will deliver our response to that account. If you do not have an account with us, we will deliver our response by mail or electronically, depending on your preference. The response we provide will also explain any reasons why we cannot comply with a request.

You may only make a consumer request for access twice within a twelve-month period. Any disclosures we provide will apply to the twelve-month period preceding the consumer request's receipt.

Contact Us

If you have any questions regarding our Privacy Notice or practices, please contact us or send your written request to: CCPA@oldrepublictitle.com, 1-855-557-8437, or 3000 Bayport Drive, Suite 1000 Tampa FL 33707

ASSESSOR'S MAP 3

Code Area Nos. 17-022

GROVE TRACT NO. 2 (Bk. 3 Pg. 31)

P.M. 8901 292 / 81-82

41

Scale: 1" = 50'

10-21-06 LL
6-05-06 LL
10-17-84 ST
03-06-07 CC
6-22-07 CC

Revised: 3-9-70 MC
10-17-84 ST
11-03-93 CSL

Drawn: 12-67 S.Y.

20TH ST.

39

8/713

20TH

STREET

80.5

43

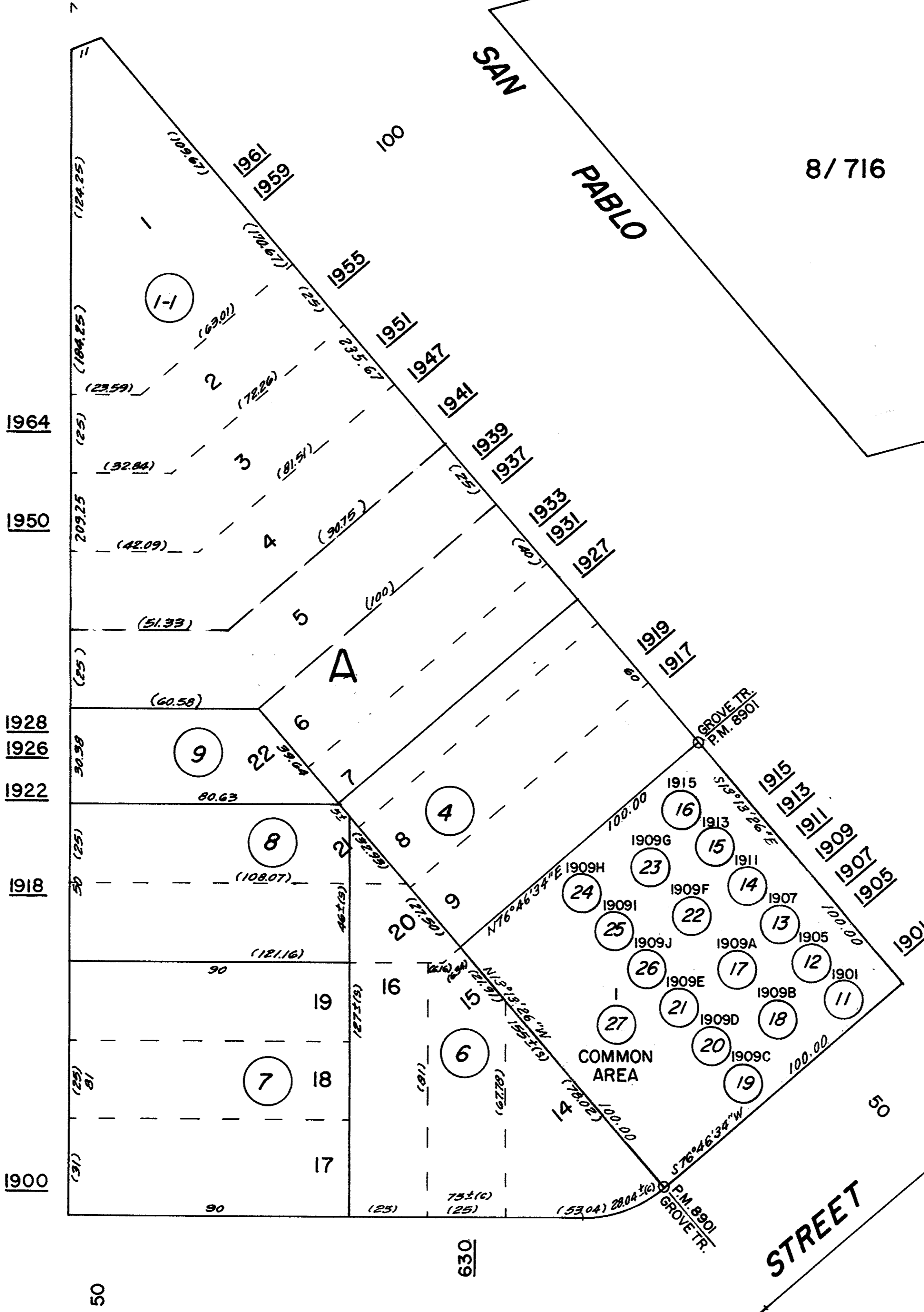
WAY

SAN PABLO

8/716

WILLIAMS

ST.



19TH ST.

8/716

AVENUE

MARTIN LUTHER KING, JR.

43

STREET

JEFFERSON

80.5

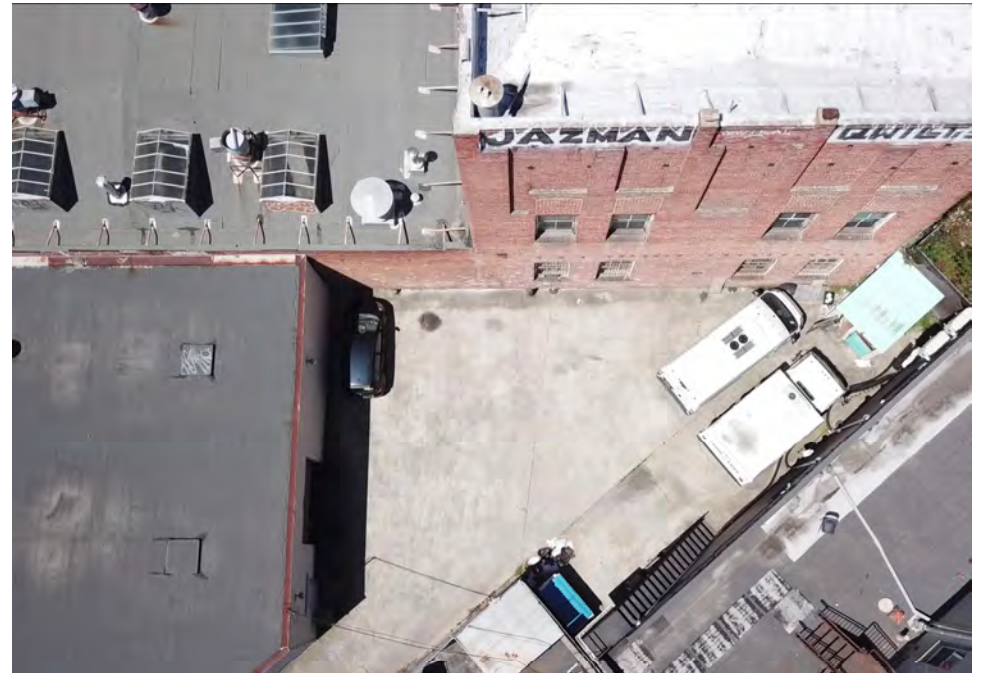
19TH

61

18TH ST.

Formerly: Blk. 243, 12-67.









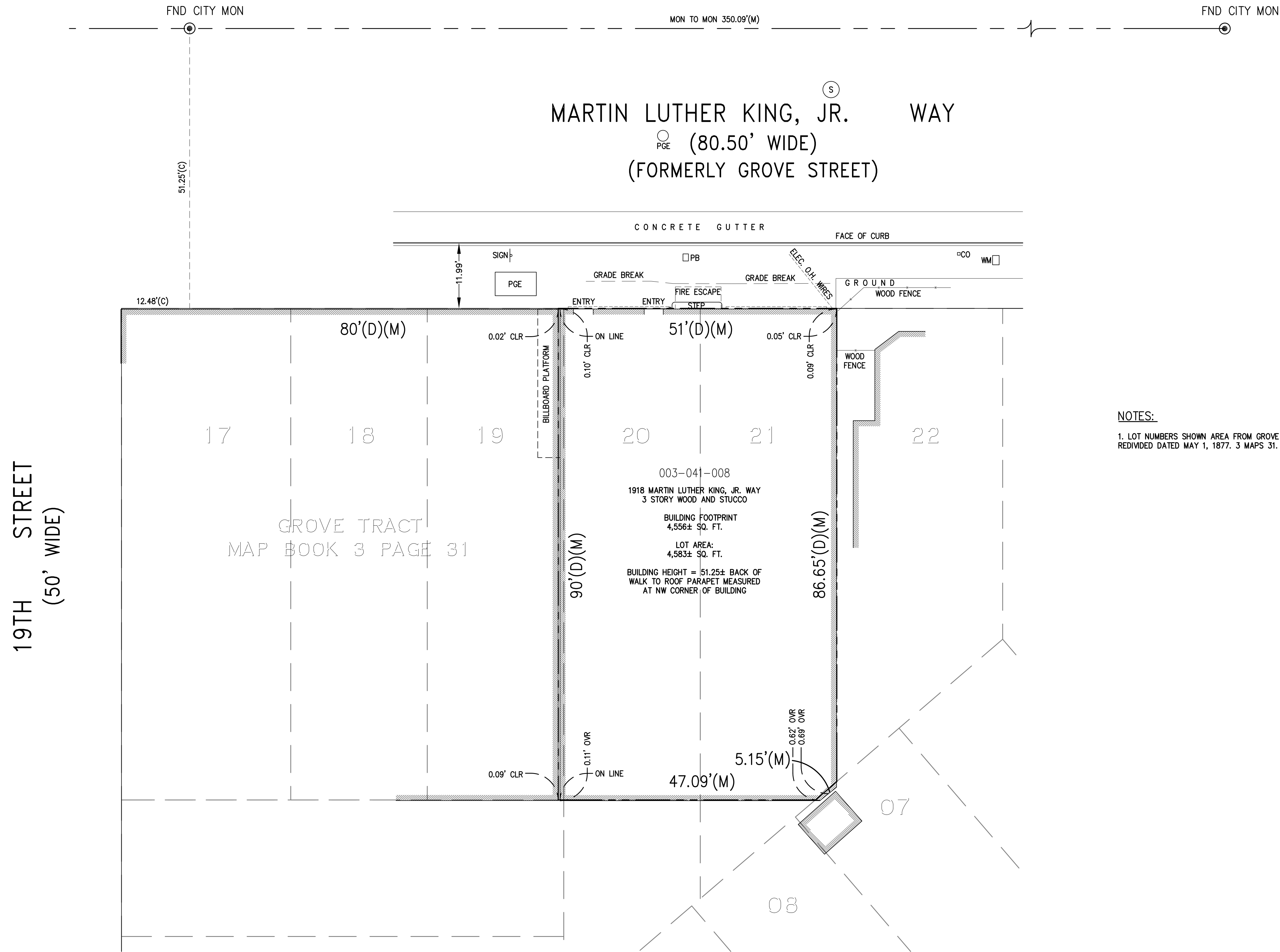










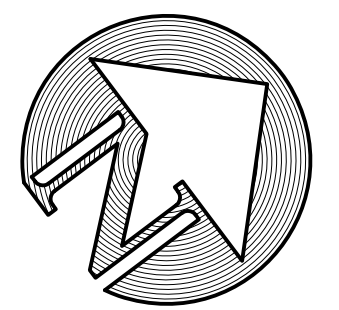


NOTES:

1. LOT NUMBERS SHOWN AREA FROM GROVE TRACT
REDIVIDED DATED MAY 1, 1877. 3 MAPS 31.

ABBREVIATIONS:

- AC ASPHALT CONCRETE
- BW BACK OF WALK
- CATV CABLE TV
- CO CLEANOUT
- FL FLOW LINE
- GV GAS VALVE
- NPS NP PARKING SIGN
- PACB PACIFIC BELL
- PGE PO&E BOX
- PM PARKING METER
- SBC SBC BOX
- SL STREET LIGHT
- SLB STREET LIGHT BOX
- TC TOP OF CURB
- UNK UNKNOWN
- WM WATER METER

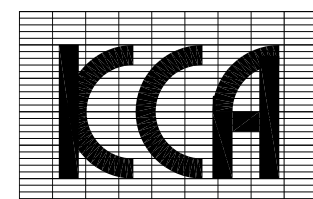


GRAPHIC SCALE



(IN FEET)
1 inch = 10 ft.

KCA ENGINEERS, INC.
CONSULTING ENGINEERS • SURVEYORS • PLANNERS



APPROVED: _____
APPROVED: _____

PROJECT NO.	DES. GW	DRW. YL			
	CKD.	REVD. PJB			
DATE	DEC. 2017				
JOB NO.	6451		01.12.18	PRELIMINARY	
			NO.	DATE	DESCRIPTION

SAN FRANCISCO

BOUNDARY SURVEY MAP FOR
1918 MARTIN LUTHER KING, JR. WAY
APN: 003-041-008

CALIFORNIA

SCALE:
HORIZ. 1" = 10'
VERT. _____
1 OF 1

VIA LIFE CYCLE COST ANALYSIS



**THE COUNTY OF ALAMEDA SUPPLEMENTAL GUIDELINE
FOR
LIFE CYCLE COST ANALYSIS**

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1.01 INTRODUCTION

The County of Alameda General Services Agency (GSA) is committed to building cost-effective, high-quality, efficient facilities through an innovative and creative process to deliver a high level of service, care, and quality to our communities and staff. GSA is also committed to operating and maintaining facilities using the best practices to maintain, preserve, and extend the life of owned facilities.

As a local government agency committed to serving its communities, GSA as a long-term stake in its assets and has a vested interest in evaluating the life cycle implications of projects to ensure its functional and financially resilient.

Each new construction and major and minor renovation projects for that Alameda County must include a Life Cycle Cost Analysis (LCCA) to determine the lifetime costs or savings associated with energy conservation measures.

The National Institute of Standards and Technology (NIST) Handbook 135, defines Life Cycle Cost Analysis (LCCA) as “an economic method of project evaluation in which all costs arising from owning, operating, maintaining, and ultimately disposing of a project are potentially important to that decision.”

Each project or equipment alternative must satisfy all required levels of performance of occupant comfort, safety, codes and regulations, and engineering standards, system reliability, etc., but may have different initial investment costs; different operating, servicing, maintenance, and repair costs, and energy and water usage; greenhouse gas emissions, and possibly different useful lives. LCCA provides a significantly better assessment of the long-term cost effectiveness of a project or equipment purchase.

Alameda County requires an LCCA for the evaluation of project implementation alternatives at different levels of project development. The benefits of a LCCA include, but is not limited to, the following:

- Identifies and understand the trade-offs between capital cost investments and long-term cost savings and greenhouse gas emission reductions while meeting the programming and budget constraints of the project
- Identifies options and designs that have a long-terms costs savings and greenhouse gas emission reductions
- Identify and understand trade-offs between capital cost investments and operations and maintenance commitments and potential improvement to design to minimize operational costs

This technical guideline is intended to establish adequate background and provide clear directions so that clients, staff, and consultants implement a LCCA effectively and consistently across all projects.

Where this guideline differs from other specifications, this guideline shall be applied to the project and all other specifications revised to include these requirements. Where this guideline conflicts with applicable codes, the codes supersede these requirements. Refer questions and comments regarding the content and use of this document to the Alameda County Project Manager or representative.

This guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

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1.02 SUBMITTALS

- A. All electronic files and documentation that were used in the LCCA shall be handed over to GSA and remain property of GSA.
- B. The reported results should include, for each alternative: a description of the measure, annual energy cost savings, first costs, annual maintenance costs, replacement cost, anticipated lifespan, and any notes on the source of this information. A LCCA Matrix is included in the Stanford LCCA Tool, which can be used to document this information. The study length, discount rate, fuel escalation rate, maintenance escalation rate, and utility rates should also be included in the report for reference.
 - (1) Description of the project alternative
 - (2) Explanation why project alternative was selected
 - (3) Assumptions made during the LCCA
 - (4) Conceptual or schematic design intent of the alternative
 - (5) Site plan showing the integration of the proposed facility on the site and necessary site improvements (for projects involving additions or new construction)
 - (6) Detailed LCCA of the project alternative
 - (7) Summary table that compares the total life cycle costs of Initial Investment, Operations, Maintenance & Repair, Replacement, and Residual Value of all the project alternatives.

1.03 GENERAL CONSIDERATIONS

- A. A LCCA is a tool to help make financially informed design decisions and not an absolute decision-making tool as results need to be viewed in the context of the project constraints.
- B. For a project decision process, a LCCA shall start at the earliest phase in the project to minimize any cost impacts with changes. An ideal timeline for new and more complex projects would include the phases below; the project team shall meet throughout the process to establish the process, identify assumption and benchmarks, evaluate, and select the greatest cost benefit to GSA.
 - (1) Pre-Development Phase
 - (a) Confirm consultant project team understand and include an LCCA scope
 - (b) Development of a basis of design (BOD) and project goals
 - (2) Concept Phase: Identify project goals, assumptions, and benchmarks
 - (a) Operations and Maintenance Targets
 - (b) LCCA assumptions and benchmarks
 - (3) Schematic Design (SD) Phase: Identify the greatest cost benefit to the project
 - (a) Energy Analysis
 - (b) Cost Estimates
 - (c) LCCA comparative analysis

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- (d) Submittal requirements
- (4) Design Development (DD) Phase: Specification Development and LCCA measures requirements
 - (a) Measures identified in LCCA
 - (b) Updated LCCA analysis and requirements
 - (c) Performance requirements of equipment and material
- (5) Construction Documentation (CD) Phase: LCCA Measure Confirmation
 - (a) For the first deliverable (25%, 50%, etc.), confirm all LCCA measures, equipment, and material are included
 - (b) Updated LCCA analysis to include any design or value engineering changes
- (6) Close-out Phase
 - (a) Final LCCA
 - (b) Close-out Submittal Package
- C. For retrofits and renovations, a LCCA shall be completed before the project begins to determine that the project meets the economic and climate action plan goals and requirements of GSA.
 - (1) For equipment replacements, these types of LCCA's may use simple spreadsheets or "back of the envelope" calculations
 - (2) For major equipment or system replacement, the LCCA shall include the process used for new project decision process.
- D. LCCA's may stop when a cost-effective design or energy conservation project has been identified.
- E. For new buildings, the current maximum service period is 40 years from the beginning of beneficial use or the permit to occupy the site.
- F. Evaluating alternative designs for a new building, the study period extends from the base year through the expected life of the building or 40 years from the beginning of beneficial use or permit to occupy, whichever is shorter
- G. The evaluating and ranking alternative retrofits for an existing building and retrofit, the study period is the expected life of the retrofit, or 40 years from the beginning of beneficial use, whichever is shorter.
- H. Determining the life cycle costs or net savings of mutually exclusive alternatives for a given building energy system or building water system (e.g., alternative designs for a particular system or size of a new or retrofit building energy system or building water system), a uniform study period for all alternatives shall be assumed which is equal to:
 - (1) The estimated life of the mutually exclusive alternative having the longest life, not to exceed 40 years from the beginning of beneficial use with appropriate replacement and salvage values for each of the other alternatives; or

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- (2) The lowest common multiple of the expected lives of the alternative, not to exceed 40 years from the beginning of beneficial use or permit to occupy with appropriate replacement and salvage values for each alternative.

1.04 STUDY CATEGORIES

- A. The following LCCA categories are recommended
 - (1) Energy Systems
 - (a) Central plant-connected vs. stand-alone systems (steam and chilled water)
 - (b) All alternative energy systems (e.g., solar photovoltaics, solar thermal, fuel cells)
 - (a) Equipment options for stand-alone systems (e.g., air-cooled chillers vs. refrigerant-based direct-expansion (DX or VRF) units or water-cooled)
 - (2) Mechanical Systems
 - (a) Air distribution systems (e.g., low-pressure ductwork vs high-pressure, overhead vs. underfloor)
 - (b) Water distribution systems (e.g., variable primary vs. constant primary, etc.)
 - (c) HVAC control
 - (3) Electrical Systems
 - (a) Indoor lighting sources and controls
 - (b) Outdoor lighting sources and controls
 - (c) Distribution Equipment (e.g., transformers, buss ducts, cable trays)
 - (4) Building Envelope
 - (a) Skin and insulation options
 - (b) Roofing systems (various materials and insulation methods)
 - (c) Glazing, daylighting, and shading options
 - (5) Siting/Massing (complex analysis)
 - (a) Orientation, floor-to-floor height, and overall building height
 - (b) Landscape, irrigation, and hardscape options
 - (6) Structural Systems
 - (a) Systems/materials selection (e.g., wood vs. steel vs. concrete, cast-in-place vs. pre-cast or low-carbon concrete)
 - (7) Interior Systems
 - (a) System/material selection for interior spaces (e.g., vinyl vs carpet, particle wood vs. recycled wood or plastic, etc.)

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1.05 ASSUMPTIONS

- A. These assumptions should remain consistent across projects, but may be revised with owner approval on a case-by-case basis
- B. Initial values for the study period, discount rate, and escalation rates are included below, but should be revised based on the Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis - Annual Supplement to NIST Handbook 135 or project specific values provided by the GSA project manager.
- C. Study Periods
 - (1) New Construction: **40 Years**
 - (2) Major Renovation: **25 years**
 - (3) Equipment Replacement: SEE Life Cycles included herein
- D. Discount Rate
 - (1) Real (excluding general price inflation): **4% (Calculation REQUIRED)**
 - (2) Nominal (including general price inflation): **8%**
 - (3) Inflation Rate: **2%**
- E. Labor Rates
 - (1) Internal Maintenance Staff: **3%**
 - (2) Construction Labor: **2%**
 - (3) Services: **4%**
- F. Utility Rates
 - (1) Baseline versus proposed rate changes
 - (2) All averages below shall use actual cost of the defined average
 - (3) Electricity:
 - (a) Energy (kWh): Calculated 3-year average
 - (b) Demand (kW): Calculated 3-year average
 - (4) Natural Gas: Calculated 3-year average
 - (5) Water: Calculated 2-year average
 - (6) Sewer: Calculated 2-year average
- G. Site Energy Use
 - (1) Adjust baseline case to for increase in energy use due to equipment degradation
 - (2) 2% for all utilities

1.06 COST COMPONENTS

- A. The sum of all cost components will be the total cost of the project over the live cycle of the project
- B. For more new buildings and large renovations, a cost estimator is advised

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- C. For smaller projects, use internal metrics and resources, RSMMeans, or similar
- D. Construction Costs
 - (1) Hard
 - Cost and or fees related directly physical construction, but not limited to, the following:
 - a) Labor
 - b) Materials
 - c) Equipment
 - d) Furnishing
 - e) Landscape
 - f) Site Work
 - (2) Soft
 - Cost and or fees related to, but not limited to, the following:
 - a) Architectural
 - b) Engineering
 - c) Master Planning,
 - d) Interior Design
 - e) Land, permits, and survey fees
- E. Recurring Costs
 - (1) Financing
 - a) Internal financing cost will be provided by GSA project manager
 - b) Third-party financing cost and escalator
 - (2) Maintenance
 - a) Preventive maintenance (PM): routine or scheduled maintenance activity. This cost should be included as a reoccurring cost in all LCCA studies.
 - b) Reactive Maintenance (RM): Unpredictable maintenance due to a failure. Depending on the frequency, this should be included in the LCCA for:
 - 1) Retrofit Projects
 - c) Planned Maintenance: Planned replacement of a building subsystem at the of its useful life. Life cycles are included herein as a reference. LCCA should include planned end of life equipment based on the equipment life cycle.
 - 1) For example, for a building life cycle of 40 years, a pump that only last 20 years would need to be replaced twice within the building life cycle. Therefore, the LCCA should have planned maintenance cost for pump replacement.
 - d) Deferred Maintenance:

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- 1) May include system or component replacement
- 2) Include only in the renovation baseline case of a LCCA
- (3) Utility
 - a) Blended utility rates are not permitted, LCCA must use time-of-use (TOU) utility rates and hours
 - b) Energy use costs may include one of the following:
 - 1) Electricity
 - 2) Natural Gas
 - 3) Water
 - 4) Sewer
 - c) Most utilities will have website to download energy data, use actual building energy data for retrofit and renovation projects when that information is available.
 - d) For equipment replacement, it is encouraged to install metering to confirm baseline energy use for more accurate information.
 - e) New Construction
 - 1) Department of Energy eQUEST energy model (current version) or similar non-proprietary system that does not require a license
 - f) Equipment Retrofits
 - 1) Simplified method may be used to estimate energy use:
 - Equivalent full-load hour and efficiency data
 - Degree-day methods
 - Excel using outside air temperature bin simulations
- (4) Services
 - a) Cost related to items that are regularly serviced by an external department, that may include:
 - 1) HVAC services for systems or subsystems (e.g., chiller bundle cleaning, boiler tuning, etc.)
 - 2) Automation control services (e.g., troubleshoot controls issues, etc.)
 - 3) Water treatment (e.g., testing of water quality)
 - 4) Janitorial,
 - 5) Pest control
 - 6) Elevators and escalators (this is a mandatory service)
 - 7) Fire pump testing

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- (5) Residual Value
 - a) Can be considering recurring depending on year system is replaced.
 - b) Value of a building or building system at the end of the LCCA study period
 - c) Important when evaluating project alternatives that have different life expectancies or when replacing equipment or building prior to their expected life cycle
 - d) A positive residual value indicates that there is some value or disposal costs associated with the building at the end of the study period
 - e) Actual residual value should be included in the LCCA; however, to simplify the study, buildings and equipment should have zero residual at the end of the LCCA
 - f) Calculated value left years into the future
 - g) Assumed to be "\$0"

- (6) Externality Costs
 - a) Impacts of greenhouse gases (GHGs)
 - b) Costs being included, either due to legislation and or utilities leading to price increase expectations or through explicit guidance.
 - c) Potential future carbon prices and electricity-related carbon emissions rates to determine the social cost of carbon
 - 1) NIST Annual Supplement a new "D" series of tables for carbon price projection
 - 2) Assume high pricing scenario, price per kg/CO₂: 3% DR (average)

1.07 SUBSYSTEM LIFE CYCLES

A. 15-Year Life Cycle

- (1) Interior Finishes
 - a) Vinyl wall covering
 - b) Interior doors and hardware
 - c) Carpet and resilient flooring

- (2) Painting – Public Areas
 - a) Painting
 - b) Public Areas includes hallways, restrooms, lobbies, stairwells, etc. (Approximately 30% of GSF.)

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- B. 20-Year Life Cycle
 - (1) Roofing
 - a) Membrane, single ply, built-up, or shingle roofing
 - b) Sheet metal flashing
 - c) Rigid insulation at roof
 - d) Roof hatches
 - e) Skylights
 - f) Applied membranes at roofs and decks
 - (2) Building Exteriors (Soft)
 - (3) HVAC – Equipment and Controls
 - a) Exchangers and circulating pumps
 - b) Fan coil units
 - c) Condensing units
 - d) Exhaust and ventilation units
 - e) Direct Digital Controls, Energy Management Systems
 - f) Pneumatic, temperature controls
 - (4) Fire Detection Systems
- C. 25-Year Life Cycle
 - (1) Elevators and Conveying Systems
 - a) Elevators, escalators, and dumbwaiters
 - b) Cables
 - c) Control Systems
 - d) Pneumatic tubes
 - e) Any vertical, motorized transportation (both hydraulic and traction)
 - (2) Built-in Specialties and Equipment
 - a) Casework and shelving, bench tops
 - b) Chalk boards, marker boards and tackable wall surfaces
 - c) Operable partitions
 - d) Fume hoods
 - e) Laboratory, medical equipment, etc.
 - f) Autoclaves, glassware washers
 - g) Cold rooms, dark room equipment

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- D. 30-Year Life Cycle
 - (1) Electrical Equipment
 - a) Building transformers, service panels and fuses
 - b) Emergency power within the building
 - c) Light fixtures
 - d) Power receptacles
 - e) Fire alarm detection devices, horns, strobes, heat detectors, pull stations
 - (2) Plumbing Fixtures
 - a) Water closets, lavatories, service sinks, drinking fountains and showers
 - b) Laboratory sinks, eye washes and fixtures
 - c) Water heaters
 - d) Floor and roof drains
 - e) Condensate drain piping
 - (3) Building Exteriors, Doors, and Windows (Hard)
 - a) Prestressed concrete, brick or cinderblock exteriors
 - b) Exterior doors and door hardware
 - c) Exterior windows, frames, glass and glazing
 - d) Caulking and sealant
 - e) Brick pointing
 - f) Railings
- E. 40-Year Life Cycle
 - (1) HVAC – Distribution Systems
 - a) Ductwork
 - b) Grilles, diffusers, piping, storage and insulation
 - (2) Fire Protection Systems
 - a) Fire sprinkler systems
 - b) Gas or halon systems
- F. 50-Year Life Cycle
 - (1) Roofing – Metal, Concrete
 - (2) Plumbing – Rough-in
 - a) Sanitary sewer waste and vent piping
 - b) Domestic and industrial water supply

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- c) Air, gas and vacuum piping
 - d) All building service piping within 5 feet of building
 - G. 80-Year Life Cycle
 - (1) Roofing - Tile
 - H. Life-Time Cycle
 - (1) Foundations
 - a) Basement excavation and disposal of excavated material
 - b) Temporary or permanent shoring for support of excavation at below-grade structure
 - c) Concrete piles, piers, footings, grade beams, caissons
 - (2) Vertical Elements
 - a) All columns and pilasters
 - b) All exterior wall framing including plaster, gypsum board and insulation
 - c) Applied fire proofing
 - d) Stairs with at least one-story height
 - (3) Horizontal Elements
 - a) Grade and non-grade floors
 - b) Beams, girders, trusses, joists and decking
 - c) Concrete topping slabs
 - d) All roof and ceiling framing
 - e) Applied fire proofing
 - f) Ceiling insulation
 - (4) Electrical – Rough-in
 - (5) Site Preparation
 - I. As-Needed Categories
 - (1) Subgrade drainage and waterproofing
 - (2) Interior partitions
 - J. Infrastructure Categories
 - (3) Site Development: Softscape, Hardscape, Distribution
 - (4) Utilities

1.08 CALCULATION METHOD

- A. For new construction and any project required to meet LEED, it is advised to use software where design information can be imported.

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B. Basic Real Discount Rate Formula

(1) $RATE_{REAL} = \frac{(1+RATE_{NOMINAL})}{(1+RATE_{INFLATION})} - 1$

(2) Where:

- a) $RATE_{REAL}$ is the Real Rate
- b) $RATE_{NOMINAL}$ is the Nominal Rate
- c) $RATE_{INFLATION}$ is the Inflation Rate

C. Basic Future Cost Formula:

(1) Calculate the value of goods and services years into the future

(2) $COST_{YEAR-Y} = COST_{YEAR-0} \times (1 + ESC)^Y$,

(3) Where:

- a) $COST_{YEAR-Y}$ is the cost at “Y” years into the future. For example, inverter replacement in 10 years, $Y = 10$, so it would be $COST_{YEAR-10}$
- b) $COST_{YEAR-0}$ is the cost at $Y = 0$, determined by a quote or estimate to replace the inverter in $Y = 0$, today's value
- c) ESC is the Escalation Rate, see assumptions
- d) Y is the number of years into the future

D. Basic Recurring Present Value Formula:

(1) Present Value of goods and services in year “0”

(2) Use escalation formula to confirm future value of goods and services

(3) Must be calculated for all recurring cost

(4) Formula:

a) $PV_{YEAR-Y} = \frac{F_{YEAR-Y}}{(1+DISC_{RATE})^{YEAR-Y}}$

b) Where:

- 1) PV_{YEAR-Y} is the present value at “Y” years into the future
- 2) F_{YEAR-Y} is the future value of the good and services, with inflation, use basic future cost formula to estimate
- 3) $DISC_{RATE}$ is the real discount rate without inflation
- 4) $YEAR-Y$ is the number of years in the future

E. Basic LCCA Formula

(5) $LCCA = C + PV_{RECURRING} - PV_{RESIDUAL_VALUE}$, Where:

- a) C is the Year “0” hard and soft costs
- b) $PV_{RECURRING}$ is the present value of all recurring cost
- c) $PV_{RESIDUAL_VALUE}$ is the residual value of the project, assumed to be \$0

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1.09 SOFTWARE OPTIONS

- A. BLCC, The NIST “Building Life Cycle Cost” Program (<https://www.nist.gov/services-resources/software/building-life-cycle-cost-programs>)
- B. One Click LCA, Whole building life cycle assessment for LEED projects (<https://www.oneclicklca.com/>)
- C. Open Source Life Cycle Assessment software like openLCA (<https://www.openlca.org/>)
- D. For smaller and less complex projects like simple equipment replacement and HVAC projects, custom Excel templates based on the LCCA calculation method is sufficient.

1.10 PAYBACK PERIODS

- A. 15 years or less: Required to be incorporated into the project
- B. 15 to 25 years: Encouraged
- C. 25 to 30 years: Discretionary

1.11 END OF DOCUMENT

VI.B CONTROL SYSTEMS



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1.01 INTRODUCTION

The County of Alameda General Services Agency (GSA) created control system guideline to guide design and construction professionals to be used in all new construction, renovations, and retrofit work. The intent of this design guideline is to streamline the design process and equipment selection by providing design and construction professionals with performance-based criteria rather than prescriptive standards so that all controls systems are designed to the same performance criteria.

Standardizing control system performance criteria are critical in terms of allowing the staff involved with operating the building to quickly interpret what is going on with systems and respond appropriately to minimize issues. Benefits of this guideline, include, but not limited to, the following:

- A. Increased safety, interoperability, and compatibility between equipment by minimizes incompatible technologies
- B. Increased serviceability and staff response time in resolving system issues
- C. Simplifies the analysis, testing, troubleshooting, recommissioning, commissioning, and the maintenance with systems
- D. Standardization of equipment that increases inventory of equipment and availability for facilities
- E. Improved energy efficiency

This guideline is not a specification, however, the performance criteria included herein is required for control system projects, in whole or in part, in a specification or included as attachment, or exhibit. Each project will have unique requirements and this guideline may not include all the information required to develop a complete specification; therefor it is not permitted to copy the guideline verbatim in specifications or in notes on drawings unless authorized by GSA. Refer questions and comments regarding the content and use of these documents to the GSA Project Manager or representative.

Where this guideline conflicts with applicable codes, the codes supersede these requirements. Refer questions and comments regarding the content and use of these documents to the Alameda County Project Manager or representative.

Due to the nature and advancement of technology, this guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

1.02 RELEVANT DESIGN STANDARDS

- A. Not all relevant standards and guidelines are included or referenced in this document. Additional guidelines, if available, will be provided as separate guideline as part of a more comprehensive set of guidelines for County projects. It is the responsibility of the design and construction professionals to request all relevant information and standards from the County Project Manager or County representatives.

1.03 DEFINITIONS and ACRONYMS

- A. NOT USED

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1.04 SUBMITTALS

- A. Submittals shall be in a binder and appropriately tabbed by equipment
- B. Submit two (2) hard copies and one (1) electronic copy of all submittals
- C. Details of control panel faces, including controls, instruments, and labeling
- D. Manufacturer's data on all hardware and software products
- E. Product data sheet for each component
- F. Valve, damper, and air flow station schedules shall indicate size, configuration, capacity, and location of all equipment
- G. Calculation methodology and sizing calculations of all valves and damper actuators.
- H. Sensor Submittals shall include size, configuration, range, and location of all equipment
- I. Installation data sheet for each component
- J. Guarantees, and warranty documents for equipment and systems
- K. Backups of a control system software and devices
- L. Software
 - (1) Submit all licensing information for all software and licences used to execute the project
 - (2) Firmware and application files, including backup files
 - (3) Software revisions downloaded to devices and any pre-installed versions for all devices
- M. A matrix sheet detailing all system addresses and communication settings for the following:
 - (1) All IP network addresses, settings, switch port numbers
 - (2) All controls system device addresses & communication settings

1.05 GENERAL CONSIDERATIONS

- A. The terms “Building Automation Systems (BAS)”, “Controls” and “Energy Management Controls Systems (EMCS)” are used interchangeably.
- B. County currently has two servers licensed (large) for hardware and software with the following approved Manufacturers:
 - (1) Automated Logic Control
 - (2) Delta Controls
 - (3) No other centralized system will be permitted
- C. All lighting controls panels shall be BACnet, BTL listed, and interoperable with GSA’s approved manufacturer’s systems.
- D. All system design basis shall be BACnet, per ASHRAE Standard 135.
- E. All control systems (lighting, HVAC, electrical, etc.), including all hardware and software,

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shall be BACnet® Testing Laboratory (BTL) as defined by ASHRAE 135.

- F. All control systems devices used to complete the project shall be licensed for owner use and to receive firmware upgrades for a minimum of five (5) years.
- G. Upgrade all firmware version for all devices or all existing and new devices.
- H. Owner shall have full read, write, and update capabilities for new and existing systems such that there is no loss of features, functionality, or control for existing and new ones.
- I. Manufacturer's service tool software, keys or licensing dongles, and other proprietary tool to access or install the software and equipment shall be provided to the owner.
- J. Integration of existing non-BACnet equipment may use Niagara Jaces (models used shall not be discontinued at the time of installation) to connect major non-BACnet equipment to one of the owners approved control systems manufacturer upon review and approval of owner.
- K. For new buildings, no field servers or any protocol translator that is used integrate non-BACnet systems into GSA's approved control system manufacturer will be permitted.
- L. Electrical system frequency: 60 Hz
- M. All controls equipment and panels shall operate under the following ambient conditions:
 - (1) Humidity: up to 95% RH
 - (2) Temperature: 20 °F to 130 °F
- N. All software points that have multiple outputs (e.g., operating modes, error codes, etc.) shall display the output clearly whether through the output value or a legend that is easily accessible from within the user's interface. Approval of final display to be provided by the owner.

1.06 CONTROLLERS

- A. Onboard flash memory to restart automatically when controller is de-energized and re-energized
- B. In the event of a communication issue or power loss to a part of the building, control systems shall be designed such that each system shall operate under stand-alone mode
- C. Each mechanical system shall have a dedicated controller
- D. Controllers shall include twice the required input and output required by the project.

1.07 WIRING

- A. Installed in conduit or raceways
- B. Meet ASHRAE standard 135

1.08 ENCLOSURES

- A. Controllers shall be installed in enclosure suitable for the environment.
- B. Wet locations shall meet National Electrical Manufacturers Association (NEMA)

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standards

- C. Exterior enclosures shall be corrosion resistant and waterproof
- D. Enclosure shall be 50% larger than what is required by the project for future expansion. For system that use dim rails, dim rail length shall be maximized for future expansion.
- E. Controls equipment shall be installed neat and orderly
- F. Enclosures shall include sealed panel pocket to protect and store relevant documents

1.09 AIR SYSTEMS

- A. General
 - (1) Sensors in wells shall use a thermal paste or other potting material
- B. Duct Temperature Sensors
 - (1) Thermistor or platinum RTD
 - (2) Used where the coil or duct area is less than 9 square-feet
 - (3) Accuracy: ± 1 °F over a range of 20 °F to 120 °F
- C. Duct Averaging Temperature Sensors
 - (1) Thermistor or platinum RTD
 - (2) Use in ducts that are larger than 9 square feet
 - (3) 1-foot element per 2 square feet of duct cross-sectional area
 - (4) Require in all return, supply, and mixed air ductwork
 - (5) Constructed of rigid or flexible copper tubing
 - (6) Accuracy: ± 1 °F over a range of 20 °F to 120 °F
 - (7) NIST Calibration and Certificate
- D. Outside Air Temperature Sensors
 - (1) Installed on the building's north side
 - (2) Where installation location is not optimal, coordinate with County project manager on an approved location
 - (3) Probed encased in PVC solar radiation shield and mounted in a weatherproof enclosure
 - (4) Accuracy: ± 0.5 °F over a range of -40 °F to 130 °F
 - (5) NIST Calibration and Certificate
- E. Humidity Transmitters
 - (1) Applications:
 - a) Wall
 - b) Duct

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- c) Outside
 - (2) Have replaceable sensing element
 - (3) Sensor type shall be thin-film capacitive
 - (4) Accuracy: $\pm 2\%$ RH of reading at the calibrated measurement
 - (5) Sensor element shall contain multipoint calibration on-board in nonvolatile memory
 - (6) Outputs shall be Field selectable Outputs:
 - a) 4-20mA
 - b) 0-5VDC
 - c) 0-10VDC
 - (7) 24 VAC supply power
 - (8) Option of having an LCD display
 - (9) NIST Calibration and Certificate, sensor to remain in calibration for 5 years.
 - (10) Option of an integrated temperature sensor
- F. Carbon Dioxide Transmitters
- (1) Applications:
 - a) Wall
 - b) Duct
 - (2) Sensor type shall be non-dispersive infrared (NDIR)
 - (3) Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval
 - (4) Accuracy: ± 30 ppm $\pm 2\%$ of measured value
 - (5) Response Time shall be < 60 seconds for 90% step change
 - (6) Outputs shall be Field selectable Outputs:
 - a) Analog: 4-20mA
 - b) 0-5VDC
 - c) 0-10VDC
 - (7) 24 VAC supply power.
 - (8) System operating range: 32° to 122°F
 - (9) Output range shall be programmable 0-2000 or 0-5000 ppm
 - (10) Transmitter shall have an option of an LCD display
 - (11) Transmitter shall have option of an integrated temperature sensor and/or humidity sensor

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- (12) NIST Calibration and Certificate
- G. Air Pressure Transmitters
 - (1) Microprocessor profiled ceramic capacitive sensing element
 - (2) System operating ranges: 0.1 – 10” WC, selectable
 - (3) Field configurable to mount on wall, panel, or duct with static probe
 - (4) Field selectable for unidirectional or bidirectional
 - (5) Maximum operating pressure: 100% of design pressure
 - (6) Outputs shall be field selectable:
 - a) 4-20 mA
 - b) 0-5 VDC
 - c) 0-10 VDC
 - (7) 24 VAC supply power
 - (8) Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
 - (9) LCD display
 - (10) Units shall be field selectable for WC or PA
 - (11) Transmitter shall have provision for zeroing by pushbutton or digital input
 - (12) NIST Calibration and Certificate
- H. Airflow
 - (1) Terminal Units
 - a) Accuracy: $\pm 10\%$ of reading
 - (2) Measuring Stations
 - a) Accuracy: $\pm 5\%$ of reading
- I. Damper Actuators
 - (1) Direct-coupled damper actuators for minimum 60,000 full-stroke cycles at rated torque
 - (2) Five-year warranty
 - (3) Actuator sized for torque required plus 25 percent
 - (4) Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch
 - (5) Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism
 - (6) Non-Spring Return Actuators shall stay in the position last commanded by the controller with an external manual gear release to allow positioning when not powered

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- (7) Power Requirements: 24VAC/DC, 120 VAC, or 230VAC, depending on application
 - (8) Proportional Control or Multi-function Technology (MFT) actuators only. No others permitted
 - (9) Actuator input options:
 - b) 0 to 10 Vdc
 - c) 2 to 10 Vdc
 - d) 4 to 20 mA
 - (10) NEMA type 2 with NEMA type 4 available for applications requiring higher ratings
 - (11) Torque suitable for application
 - (12) Tandem mount or gang mount.
 - (13) Stops automatically at end of travel
 - (14) Permanently lubricated gear train
 - (15) Approved Manufacturer: Belimo or approved equal
 - (16) Position feedback or end switches
- J. Duct Differential Pressure Switch
- (1) Set point adjustable with operating range of 0.5 to 12-inch WG
 - (2) Switches UL listed
 - (3) SPDT snap-acting
 - (4) Pilot duty rated (125 VA minimum)
 - (5) Scale range and differential suitable for intended application.
- K. Carbon monoxide Sensor
- (1) Field selectable CO range of 1 to 100, 0-200, 0-300 and 0-500 ppm.
 - (2) Field selectable output of 0-5, 1-5, 0-10, 2-10 VDC, 3-wire 4-20 mA output.
 - (3) Option of LCD display.
 - (4) Two independent SPDT alarm contacts switch at field selectable CO concentration of 25, 35, 50, 100, 200 ppm.
 - (5) Alarm timer can hold the output relay ON for one to ten minutes after the CO level has fallen below 80% of setpoint, to allow fan to purge CO.
 - (6) Must self-test daily and field replaceable sensor element life to be up to 7 years.
 - (7) Power supply to be 18 to 28 vac or 18 to 40 VDC.
 - (8) Operating environment range to be 14 to 122 Deg F, 5 to 95% RH Noncondensing.

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- (9) RoHS and CE certification.
- (10) Accuracy to be $<200\text{ppm} = \pm 3\% \text{ FS}$, 32 to 122 Deg F; 201 to 500 ppm = $\pm 5\% \text{ FS}$, 50 to 122 Deg F.

L. Current Transducers

- (1) Full scale input ranges from 0 to 2 Amp and 2 – 2000 Amp.
- (2) 4 to 20 mA (24 VDC loop-powered) and 0 – 10 VDC volts (Self-powered)
- (3) True RMS current sensing where applicable.
- (4) Split-core or fixed-core as applicable.

M. Current Switches:

- (1) Current operated switches shall be self-powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication.
- (2) The switches shall be selected to match the current of the application and output requirements of the DDC systems.

N. Filter Differential Pressure Switch

- (1) Set point adjustable with operating range of 0.1 to 5-inch WG with auto reset
- (2) Contactor to close when pressure differential setting is met or exceeded
- (3) Metallic tubing to duct or air-handling unit.

1.10 WATER SYSTEMS

A. Pipe Immersion Temperature Sensors

- (1) For all water-side systems as well as refrigerant applications.
- (2) Sensor probe length and well suitable for application.
- (3) Thermistor or platinum RTD element.
- (4) Sensor wells shall be stainless steel for non-corrosive fluids below 250 °F and 300 °F series stainless steel for all other applications.
- (5) Accuracy: $\pm 0.5 \text{ }^\circ\text{F}$

B. Liquid Differential Switches

- (a) Set point adjustable with operating range 5 to 30-feet WC.
- (b) Switches UL listed
- (c) SPDT snap-acting
- (d) Pilot duty rated (125 VA minimum)
- (e) NEMA 1 enclosure at a minimum
- (f) Scale range and differential suitable for intended application.

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- C. Liquid Differential Pressure Transmitters
- (1) Microprocessor based
 - (2) System operating range from 0 to 50 PSIG
 - (3) Two independent gauge pressure sensors to measure and calculate differential pressure
 - (4) Four (4) switch selectable ranges
 - (5) Linear signal
 - (6) Stainless steel diaphragm
 - (7) Test mode to produce full-scale output automatically.
 - (8) Zeroing by pushbutton or digital input.
 - (9) Field selectable outputs:
 - a) 0-5V
 - b) 0-10V
 - c) 4-20mA
 - (10) Field selectable electronic surge damping.
 - (11) Accuracy:
 - a) $\pm 2\%$ of full scale, absolute & differential pressure
 - b) $\pm 1\%$ at lowest range, absolute & differential pressure
 - (12) Transmitter shall have an electronic port swap feature.
 - (13) 24 VAC supply power
 - (14) Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
 - (15) System operating temperature range: 30° to 240°F.
 - (16) Proof pressure shall be 2x max. F.S. range.
 - (17) Burst pressure shall be 5x max. F.S. range.
 - (18) Enclosure for wet locations, NEMA 4, and suitable for the environment.
 - (19) NIST Calibration and Certificate
- D. Water Flow Meters
- (1) Systems required to have water flow monitoring
 - a) Chilled and Condenser Water
 - b) Condenser Water
 - c) Hot and Tempered Water
 - d) Service Water
 - e) Water Softeners

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- f) Kitchen
- g) Laundry
- h) Steam Systems
- (2) Hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain
- (3) Electromagnetic Flow Meter
 - a) Used in systems where electrical conductivity of the liquid is greater than approximately 5 μ S/cm
 - b) Transmitter Enclosures: NEMA 4 rated
 - c) Sensors shall be integrated and accessible through the building energy management control system
 - d) NIST Calibration and Certificate
 - e) Approved Manufacturer: Onicon
 - f) System operating pressure: 0 to 400 PSIG
 - g) System operating temperature range: 30° to 240°F
 - h) Insertion Type:
 - 1) Hot tap adapter installation with a full port isolation valve for removal and re-installation without shutting the system down.
 - 2) Stem assembly shall be constructed of 316/316L SS
 - 3) Electrodes shall be constructed of 316/316L SS
 - 4) Seal shall be EPDM
 - 5) Hot tap adapter shall be constructed of 316/316L SS
 - 6) Accuracy:
 - $\pm 0.5\%$ of reading at calibrated velocity
 - $\pm 1.0\%$ of rate from 1.0 to 20.0 ft/sec velocity (20:1 turndown).
 - $\pm 0.01\%$ ft/sec below 1 ft / sec
 - i) Full Bore/In-Line Type:
 - 1) Electromagnetic sensing element shall utilize a minimum of two 316L stainless steel electrodes
 - 2) 304 stainless steel flow tube and integral liner to be selected based on operating temperature and fluid
 - 3) ANSI Class Flanges suitable for the system: 150/300 flanges
 - 4) Accuracy:
 - $\pm 0.2\%$ of rate from 1.6 to 33.0 ft/sec velocity.

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- ± 0.0033 ft/s at flow rates < 1.6 ft/s
- (4) Turbine Flow Meter:
- a) Pipe size range from $\frac{3}{4}$ " (inch) and greater
 - b) Bluetooth connectivity
 - c) NIST Calibration and Certificate
 - d) Dual-Turbine - two contra-rotating axial turbines
 - e) Outputs:
 - 1) 4 – 20 mA
 - 2) 0 – 10 V
 - 3) 0 – 5 V
 - f) Accuracy:
 - 1) $\pm 1\%$ of reading over a 10:1 turndown (3.0 to 30 ft/s)
 - 2) $\pm 2\%$ of reading over a 50:1 turndown (0.4 to 20 ft/s)
 - g) System operating range: 30 °F to 300 °F
 - h) Maximum operating conductivity: 1200 PPM
 - i) 24 VAC supply power
 - j) Typical turndown range: 10:1
 - k) Maximum operating pressure: 400 psi, hand insertable
 - l) Maximum operating temperature: 300 °F
 - m) Materials: 316L stainless steel or brass body; stainless steel impeller
- (5) Ultrasonic Flow Meter
- (a) Accuracy:
 - 1) Pipe diameters from 1/2" to 3/4": 1% of full scale
 - 2) Pipe diameters from 1" to 2": 1% of reading from 4.0 to 40 ft/s
 - 3) Pipe diameters from 2" to 100": 1% of reading from 1.0 to 40 ft/s
 - (b) Pipe size diameters from 1/2" to 16"
 - (c) Bidirectional flow
 - (d) Pipe Temperatures up to 300 °F
 - (e) Flow Sensitivity: 0.001 ft/s
 - (f) Automatic temperature compensation
 - (g) Liquids Measured
 - 1) Water (chilled, hot, and service)

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- 2) Saltwater Brine
- 3) glycol
- E. Flow Switches
 - (1) Not permitted
 - (2) All flows and control of equipment shall use a flow meter.
- F. Valves Actuators
 - (1) Ball Valves
 - j) Pipes less than 2 inches in diameter
 - k) Only to be used on/off control
 - l) Size for torque required for valve close-off pressure at system design.
 - m) equipped with pigtail leads, manual override, and auxiliary switch(es)
 - n) Position feedback or end switches
 - (2) Globe Valves
 - a) Actuator sized for torque required plus 25 percent
 - b) Proportional Control or Multi-function Technology (MFT) actuators only. No others permitted.
 - c) Fluid system operating temperature ranges
 - (3) Chilled water from 30 °F to 60 °F
 - (4) Heating Hot Water from 30 °F to 220 °F
 - (5) Domestic Tempered from 30 °F to 160 °F
 - d) AC/DC 24 V power supply
 - e) Position feedback
 - f) Internal torque protection throughout stroke
 - g) Rated for up to NEMA 2/ IP54
 - h) Direct mount to valves without separate linkage, except where approved
 - i) Manual override to allow positioning of valve and preload.
 - j) Overload protection over range of torque
 - k) Electrical protection, double insulated actuators
 - l) Actuator input options:
 - 1) 0 to 10 V
 - 2) 2 to 10 V
 - 3) 4 to 20 mA
 - m) Approved Manufacturer: Belimo or approved equal.

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- (3) Butterfly Valves
 - (a) Proportional Control or Multi-function Technology (MFT) actuators only. No others permitted.
 - (b) Actuator input options:
 - 1) 0 to 10 V
 - 2) 2 to 10 V
 - 3) 4 to 20 mA
 - (c) 24 VAC power supply
 - (d) Position feedback
 - (e) End Switch to confirm valve is closed
 - (f) Rated for up to NEMA 2/ IP54
 - (g) Fluid system operating temperature ranges
 - 1) Chilled water from 30 °F to 60 °F
 - 2) Heating Hot Water from 30 °F to 220 °F
 - 3) Domestic Tempered from 30 °F to 160 °F

G. Water Treatment

- (1) Systems required to have water chemical treatment:
 - a) Chilled and Condenser Water
 - b) Condenser Water
 - c) Hot and Tempered Water
 - d) Service Water
 - e) Water Softeners
 - f) Kitchen
 - g) Laundry
 - h) Steam Systems
- (2) Size of controller and number of metering pumps as required by systems being treated.
- (3) Minimum measurements:
 - a) Conductivity ($\mu\text{S}/\text{cm}$) accuracy of $\pm 1\%$ of reading
 - b) pH accuracy of $\pm 0.01\%$ of reading
 - c) Orp, accuracy of ± 1 mV
 - d) Temperature accuracy of $\pm 1\%$ of reading
- (4) Approved manufacturer: Walchem or equivalent

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1.11 ELECTRICAL SYSTEMS

- A. Power will only be monitored, and alarms annunciated, but not controlled.
- B. For systems installed in secure facilities, coordinate power monitoring equipment selection with County project manager.
- C. Where systems power data can be acquired from the equipment directly (e.g., VFDs, Chiller on-board controller, etc.), accessed through the building's energy management control system and meets the power monitoring below, a power meter does not need to be installed.
- D. Installed in an appropriated enclosure suitable for the environment
- E. Integrated into and accessible from the building energy management control system.
- F. Approved Manufacturers
 - (1) eGauge
- G. Power Monitoring:
 - (1) Power Monitoring is required for the following:
 - a) Whole Building Power, calibrated to local utility data
 - b) Solar Systems
 - c) Chilled Water Plants
 - d) Electric Boiler Plants
 - e) Electric Hot Water Tanks
 - f) Electric Motors over 5 horsepower
 - g) Lighting Electric Panels
 - h) Plug Load Electric Panels
 - (2) Accuracy: $\pm 0.05\%$, revenue grade
 - (3) Maximum Current: Up to 6000A
 - (4) Maximum Voltage: Up to 480V
 - (5) Minimum Monitoring Interval: 1 minute, adjustable by 15-minute increments
 - (6) Logging Values:
 - a) Volts (V)
 - b) Current (A)
 - c) Energy (kWH)
 - d) Instantaneous Power (kW)
 - e) Total Harmonic Distortion (THD)
 - f) Volt-Amps Reactive (VARs)
 - (7) Local Data Storage up to 5 Years

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- (2) Voltage Transmitters
 - (1) Self-powered single-loop (two-wire) type.
 - (2) 4 to 20 mA output with zero and span adjustment
 - (3) UL/CSA recognized at 600 VAC rating and meet or exceed ANSI Standards
 - (4) Voltages up to 480 V
 - (5) Full-scale, adjustable, with plus or minus 1 percent full-scale accuracy with 500-ohm maximum burden.
- (3) Voltage Transformers
 - (1) AC voltage transformers UL/CSA recognized
 - (2) 600 VAC rated
 - (3) Built-in fuse protection
 - (4) $\pm 0.5\%$ percent accuracy
- (4) Current Transducers
 - (1) Required for equipment where system power information cannot be acquired from the equipment
 - (2) Current transducers shall be used to monitor the current of motors less than 5 horsepower.
 - (3) Integrated into the building's energy management control system for ongoing monitoring
 - (4) Current Transducers
 - a) Microprocessor based, self-learning, self-calibrating current switch
 - b) Auto-Calibration
 - c) 4 to 20 mA (24 VDC loop-powered) and 0 – 10 VDC volts (Self-Powered)
 - d) Accuracy: $\pm 1\%$
 - e) Slide-switch selectable trip point limits
 - f) Split or solid core sensor
 - g) Full scale input ranges from 0 -300 Amp or 2 – 2000 Amp
 - h) Detect motor undercurrent and overcurrent
 - i) True RMS current sensing where applicable
- (5) Relays
 - (1) Control relays
 - a) Contact rating, configuration, and coil voltage be suitable for application.
 - b) UL listed plug-in type with dust cover and LED “energized” indicator.

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- (2) Time delay relays
 - a) UL listed solid-state plug-in type with adjustable time delay.
 - b) Delay adjustable plus or minus 200 percent (minimum) from set point or as indicated.
 - c) Contact rating, configuration, and coil voltage be suitable for application
 - d) NEMA 1 enclosure when not installed in local control panel.

1.12 LIGHTING SYSTEMS

A. General

- (1) Interior and Exterior lighting controllers and panels shall be interoperable with the approved HVAC manufacturers BAS without the use of protocol translators, field servers, etc.
- (2) Lighting controllers and wiring shall be BACnet and BTL listed.
- (3) Systems to include interior and exterior lighting controls, controllers, relays, contactors, and wiring that meet BACnet standards.
- (4) Lighting controller shall be and interoperable with building BAS per the most recent version of *ANSI/ASHRAE Standard 135* for full system integration.
- (5) Lighting control system shall have the ability to operate stand-alone with following system features:
 - a) Daylight harvesting
 - b) Occupancy control
 - c) Smart time scheduling
 - d) Task tuning
 - e) Personal control
 - f) Load shedding.

B. Interior Lighting Control System (LCS)

- (1) Wired or wireless are acceptable if they can be monitored using the buildings BAS
- (2) Passive Infrared (PIR) sensors with dual technology for all interior lighting control that
- (3) Occupancy Sensors
 - a) Wireless and wired solution are allowed
 - b) Battery operated sensors are not permitted, unless authorized by GSA
- (1) Private Rooms
 - (a) Daylight harvesting controls for all perimeter offices shall dim continuously to balance daylight and dim to a minimum 10% before switching off fixture(s).

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- (b) Hardwired I/O module interfaced with BAS controls.
- (2) Open Rooms
 - (a) Occupancy sensor control in all open office areas. Configure open office with auto on/off. Provide dimming as required by Code.
 - (c) Daylight harvesting controls for all perimeter offices shall dim continuously to balance daylight and dim to a minimum 10% before switching off fixture(s).
 - (b) Hardwired I/O module interfaced with BAS controls.
- (3) Conference Rooms
 - (a) Multi-zone controls for all conference rooms.
 - (b) Light fixtures closest to projection screens or monitors shall be on a separate lighting zone form the rest of the room.
 - (c) Occupancy sensor controls configured with manual on and auto off and dimming controls. Provide dimming to minimum 1%
 - (d) Hardwired I/O module interfaced with BAS controls.
- (4) Libraries
 - (e) Multi-zone controls.
 - (f) Light fixtures closest to projection screens or monitors shall be on a separate lighting zone form the rest of the room.
 - (g) Occupancy sensor controls configured with manual on and auto off and dimming controls. Provide dimming to minimum 1%
 - (h) Hardwired I/O module interfaced with BAS controls.
- (5) Restrooms
 - (a) Occupancy sensor controls configured with manual on and auto off and dimming controls.
 - (b) Hardwired I/O module interfaced with BAS controls.
- (6) Lobbies and Corridors
 - (a) Occupancy sensors configured for automatic on/off.
 - (b) Daylight harvesting dimming to minimum 10% before turning off fixtures where possible. Coordinate occupancy time delay with the County.
 - (c) Egress lighting may be controlled under certain conditions. Coordinate with the County.
 - (d) Hardwired I/O module interfaced with BAS controls.

C. Exterior

- (1) Shall include photoelectric sensor for exterior lighting control

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- (2) Occupancy Sensors

1.13 NATURAL GAS

- A. Required on all natural gas systems where the natural gas input exceeds 1MMBtus
- B. Where the equipment's natural gas use can be acquired from the equipment directly and accessed through the buildings energy management system and meets the technical requirements in the following section, a natural gas meter does not need to be installed.
- C. Natural Gas Meter
 - (1) Insertable thermal mass flow meter: up to 6" pipe diameter
 - (2) 2" dial size, digital flow display with various flow units
 - (3) Insertion thermal mass controller outputs:
 - a) 4 – 20 mA
 - b) 0 – 5 V
 - (4) Frequency, pulse, alarm outputs
 - (5) Digital thermal mass flow transmitter
 - (6) Turndown ratio: 100:1, can detect low velocity gas flow
 - (7) Direct gas flow measurement without the need for temperature and pressure compensation

1.14 BUILDING

- A. Building Static Pressure Transducer
 - (1) Operating range of -0.1 to 0.1-inch WC, linear signal
 - (2) Sensing tubes located inside and outside building use shielding and/or surge tanks to minimize effects of wind
 - (3) Accuracy: $\pm 1.0\%$, percent of full scale

1.15 SPACES AND ROOMS

- A. Space temperature sensors criteria
 - (1) Afterhours HVAC call button
 - (2) Space Temperature and Setpoint
 - (3) CO₂ Concentration
- B. Air Pressure
 - (1) Accuracy: ± 0.01 "w.c.
- C. Occupancy Sensors
 - (1) Occupancy sensors shall be accessible via BACnet[®] to enable integration of environmental control when desired
 - (2) Dual technology passive infrared and ultrasonic sensing devices only

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- (3) Ceiling or wall mounted
- (4) Ceiling sensors shall have 360-degree coverage
- (5) Built-in self-adjusting settings, timer settings of 30 seconds to 30 minutes, with manual and automatic modes
- (6) Areas greater than a single device covers, multiple devices are required
- (7) Manual override switch

1.16 FIRE ALARM SYSTEMS

- A. Fire alarm systems will not be integrated into the control system, unless approved by the County and AHJ
- B. Where fire alarm control systems share a pneumatic system with an HVAC system and the fire alarm replacement is not part of the scope, install necessary equipment (e.g. electro-pneumatic (EP) switch) to leave the fire alarm system on pneumatic control. Field test and confirm operation with AHJ.

1.17 SECURITY SYSTEMS

- A. Camera monitoring and systems will not be integrated into the control system, unless approved by the County

1.18 PHYSICAL ACCESS SYSTEMS

- A. Access control systems will not be integrated into the control system, unless approved by the County

1.19 ELEVATOR SYSTEMS

- A. Elevator control systems will not be integrated into the control system, unless approved by the County and AHJ

1.20 COMMUNICATION and NETWORKS

- A. Physical connection of BACnet devices shall be via a balanced twisted pair, low capacitance (17 pF or less), plenum rated, 100-200 ohm wire which allows BACnet MS/TP protocol over RS-485 network or CAT-5, CAT5E, CAT6 network cable which allows Ethernet and BACnet IP communication protocols.) .
- B. Network hubs or switches that enable multiple MAC addresses on a single Access Port are not permitted.
- C. Protocol translator that converts standard or proprietary protocol of one device to the protocol suitable for the approved manufacturer's devices or tools to achieve the desired interoperability are not permitted, except in unique cases and where approved by the County.
- D. Integration of all work into County's existing control licensing servers for management and control shall be coordinated with the County project manager.
- E. Communication network shall utilize communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.
- F. Networks shall utilize only copper and optical fiber communication media as appropriate

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and shall comply with applicable codes, ordinances, and regulations.

- G. Where a physical LAN cannot be installed, native BACnet wireless devices operating on 900MHz may be used upon review and approval by the County
- H. Repeaters
 - (1) Where the communication bus exceeds its maximum recommend installed length, repeaters may be installed to connect to control bus segments with approval from the County.
 - (2) Repeaters shall be installed in an enclose in an accessible space
- I. Field Bus Wiring and Termination
 - (1) Daisy chained with no tees, stubs, or free topology.
 - (2) Termination resistor at both ends of each segment.
 - (3) Support the use of wireless communications.

1.21 END OF DOCUMENT

VI.C CONTROL SYSTEM NAMING CONVENTION



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1.01 INTRODUCTION

Purpose: The County of Alameda created control system naming standards to guide design and construction professionals to implement a consistent and logical naming convention for all new construction, renovations, and retrofit work. Control system names and descriptions are critical in terms of allowing the staff involved with operating the building to quickly interpret what is going on with the control system and respond appropriately to minimize operating issues.

This guideline is not a specification, however, the performance criteria included herein are required for control system projects, in whole or in part, in a specification or included as an attachment, or exhibit. Each project will have unique requirements and this guideline may not include all the information required to develop a complete specification; therefore it is not permitted to copy the guideline verbatim in specifications or in notes on drawings unless authorized by GSA. Refer questions and comments regarding the content and use of these documents to the GSA Project Manager or representative.

Where this guideline conflicts with applicable codes, the codes supersede these requirements. Refer questions and comments regarding the content and use of these documents to the Alameda County Project Manager or representative.

Due to the nature and advancement of technology, this guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

1.02 DEFINITIONS AND KEY TERMS

- A. The terms “Building Automation Systems (BAS)”, “Controls” and “Energy Management Controls Systems (EMCS)” are used interchangeably.
- B. Default manufacture naming is not permitted.
- C. Input and output (IO) shall include physical inputs and outputs that are wired to a controller and points not wired to a controller often called software, virtual, or values will be programmed as virtual or software points.

1.03 GENERAL CONSIDERATIONS

- A. The terms “Building Automation Systems (BAS)”, “Controls” and “Energy Management Controls Systems (EMCS)” are used interchangeably.
- B. Default manufacture naming is not permitted.
- C. Input and output (IO) shall include physical inputs and outputs that are wired to a controller and points not wired to a controller often called software, virtual, or values.
- D. In general, this document outlines the general requirements and standards for naming and describing controls systems equipment and points, including, but not limited to, all ancillary equipment and third-party devices for both new and retrofit installations. A brief list is provided below:
 - (1) Devices
 - (2) All IO Points (hardwired, software, etc.)
 - (3) Sites
 - (4) Buildings

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- (5) Systems
 - (6) Equipment
 - (7) Trends
 - (8) Alarms
 - (9) Schedules
 - (10) Wire Labeling
 - (11) Design Documents
 - (12) Wiring Diagrams
- E. A meeting between the control system provider and the Owner is required prior to any work related to the work described herein.
- F. The naming convention to be used must be submitted for review and approval by Owner prior to implementation.
- G. All third-party control systems shall adhere to the naming convention. Where there is a conflict between the third-party IO registry and this naming standard, this standard shall take precedence.
- H. Modifications, variance, or changes that deviate from this convention shall be submitted for review and approval by Owner during the project controls review period.
- I. The naming convention shall be consistent throughout all documents, drawings, specifications, equipment & wire labeling, testing, commissioning & training documents, programming and graphics.
- J. Any control object, tag or point that is not represented in this document must be submitted to the owner for review and approval. A response will be generated identifying the name that shall be used for the application. If the supplied name is not currently represented in the standard document, it may be added.

1.04 GENERAL NAMING CONVENTION RULES

- A. In general, names shall be the combination of several identifying elements that are represented by a list of standard abbreviations included in this contract. Each name will include all or some of the following attributes:
- (1) Geographic Location Attribute: North, South, or East County
 - (2) Building Attribute: building name (e.g. Lakeside, RCD, etc.)
 - (3) System Attribute: collection of components or a system such air handlers and water system loops, etc.
 - (4) Equipment Attribute: component or sub-component of a system such as chillers, boilers, dampers, valves, fans, pumps, etc.
 - (5) Equipment Attribute Modifier: commonly repeated equipment attributes such as VFDs, Inlet Vanes and Sensors
 - (6) Point Attribute: input, output, value, virtual etc.
 - (7) Point Attribute Modifier: commonly repeated point attributes such as command, high limit, low limit, maximum, minimum, setpoint, status
 - (8) Alarms, Events and Trend Attribute

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- B. Standard naming convention shall include, but not limited to, standard abbreviations, names, and or acronyms in the tables provided herein and follow the principles outlined in this document.
- C. Where an abbreviation, name, or acronym does not exist, Contractor, Design-Builder, or Subcontractor shall consult with Owner to confirm name to be used.
- D. The use of System, Equipment, or Area attributes are determined as follows:
 - (1) By the system or equipment where the value is being recorded. For example, CO2 readings in the return air duct of an air handling unit would be labeled “AHU-x RA CO2” and CO2 readings obtained at the zone would be “VAV-x-x ZONE CO2”
 - (2) By the area that would accurately represent the location being recorded. For example, the maximum CO2 reading obtained for all the VAV boxes served by AHU-x would be named “AHU-x ZONE CO2 MAX”. The total number of cooling requests for all the VAV boxes on the second floor would be named “FLOOR 2 ZONE CLG REQUESTS”.
 - (3) In cases, where multiple approaches would accurately represent the point value, the system attribute should be used instead of the equipment or area attribute and the equipment attribute should be used instead of the area attribute. For example, the VAV attribute should be used instead of the ZONE attribute for measurements in the zone served by the VAV box.
- E. A system and equipment identifier (ID) using letters, numbers, or an alpha-numeric ID shall be added to all the system and equipment names that need to be distinguished from other similar systems and equipment operating in the same building or campus. System and equipment IDs shall be approved by the project manager.
 - (1) For example, to distinguish between two air handling units where one serves the north side of the building and one serves the south side of the building, the IDs given would typically be AHU-1 and AHU-2, but could also be AHU-NORTH, AHU-SOUTH, or AHU-N1 and AHU-S1.
- F. All names shall be in capital letters.
- G. System names and system IDs shall be separated by a hyphen “-”.
- H. Equipment names and equipment IDs shall be separated by a hyphen “-”.
- I. Floor numbers shall be separated by a space.
- J. Names shall not exceed 45 characters.
- K. The standard point naming convention shall be used for all points referenced in the sequence of operation or other system functions.
- L. Contractor or Design-Builder and Subcontractor personal or company names and or initials are not allowed as part of the naming convention.
- M. Points that are used as part of construction and not used for control of the system at project completion shall include a brief description noting temporary use and may include any of the following designations:
 - (1) Balancer set
 - (2) Test
 - (3) Cx (commissioning point)
 - (4) RCx (retro-commissioning point)

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1.05 STANDARD SITE NAMING

- A. Site names shall follow the general naming convention rules.
- B. The names shall be created using a combination of the attributes listed in the SITE NAMING CONVENTION below in numerical order. For example, to create a site name, the geographic location attribute (1) would be first, separated by a space, and then the building attribute (2) would be last.
- C. The Site Name shall use a space, not an underscore “_”, between attributes. The naming convention shall include the geographic location for the building and the building name (i.e. NC Law Library for North County Law Library).
- D. SITE NAMING CONVENTION
 - (1) Geographic Location Attribute
 - (2) Building Attribute

1.06 STANDARD DEVICE NAMING

- A. System level devices (EBMGR, DSMRTR, DSC, etc.) shall use the Controller model number followed by the System or Area attributes listed in the tables herein. The System attribute shall be used unless the devices provides control for multiple systems, in which case an Area attribute or combination of the System and Area attributes shall be used. For example, to create a device name, the model number (1) would be first, separated by a space, and then the System and/or Area attribute (2) would be last.
- B. Application-level devices (e.g. DAC, VAV, etc.) names shall use the System or Equipment attributes listed in the Standard Attributes tables herein unless the controller serves multiple systems. For controllers serving multiple systems, the name will be the physical location of the device and device model.

In addition, names for the devices, and only the devices, that control zone level equipment will include the respective modifier(s):

- (1) Equipment receiving air from a central air handling unit (e.g. VAV boxes, Fan Coil Units, etc.) will include, **at the beginning**, the air handling unit name without the dash (e.g. ACx VAV-x-xx) followed by a space and then the standard device name.
- (2) Zones containing a CO2 sensor shall have “-CO2” **at the end**
- (3) Equipment with reheating coils shall have “-RH” **at the end**
- (4) Equipment with recooling coils shall have “-RC” **at the end**
- (5) Equipment with both reheating and recooling coils shall have “-RCH” **at the end**
- (6) Exhaust only equipment shall have “-E” **at the end**
- (7) Specialty Exhaust devices shall have “-XE” **at the end**
- C. The controller/device IDs shall be distinct and unique and not repeated throughout the County to minimize conflict between control devices. All device IDs shall be reviewed and approved by Owner. See relevant contract document for device IDs.

1.07 STANDARD SCHEDULE NAMING

- A. Schedule names shall use the System, Equipment or Area attributes listed in the tables herein.

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- B. The System or Equipment attribute shall be used unless the devices provides control for multiple systems or equipment, in which case an Area attribute (ZONE, FLOOR, etc.) shall be used. See section 1.03 GENERAL NAMING CONVENTION Part D for details on when to use SYSTEM, EQUIPMENT or AREA attributes.
- C. The Schedule Name shall not use an underscore “_” between attributes.

1.08 STANDARD POINT NAMING

- A. Point names shall follow the general naming convention rules.
- B. The names shall be created using the attributes listed in each of the naming convention sections below in numerical order. For example, to create a point name, the System attribute (1) would be first followed by the Equipment attribute and modifier (2), and the Point attribute modifier (3) would be last. Each attribute is separated by a space.
 - (1) EXCEPTION: Central plant pumps (PCHWP, SHHWP, etc.) shall not include a system attribute. This applies only to central plant pumps. Other systems, e.g. AHUs, shall include the system attribute.
- C. Virtual object (AV, BV, etc.) point names that would duplicate the name of another object shall use the same name, but be given a Point Attribute Modifier of “(W)” for writable or “(RO)” for read only at the end.
- D. The Point Attribute “ENABLE” shall be used for Systems to designate a system and its associated equipment is available. The Point Attribute “ON/OFF” shall be used for Equipment to designate equipment that is running.
- E. Commands and setpoints shall follow the standard naming convention but use a Point Attribute Modifier of “(SP)” for analog points or “(CMD)” for binary points.
 - (1) When there are multiple setpoints for the same value, multiple Point Attribute Modifiers shall be used. For example, the zone temperature heating setpoint should be ZONE TEMP HTG SP and the supply air temperature setpoints and reset values on AHU-x would be AHU-x SA TEMP SP, AHU-x SA TEMP MAX SP, AHU-x SA TEMP MIN SP.
- F. Multi-state points use “CMD” for outputs and “MODE” for inputs.
- G. For central plant water systems and equipment (e.g. chilled water, heating hot water, chillers, boilers, etc.), the supply water shall be named “SW” and always refers to the water leaving the equipment. The return water shall be named “RW” and always refers to the water entering the equipment. For chillers, the added equipment attribute of “COND” shall be included to designate water entering and leaving the chiller condenser. Examples include:
 - (1) CH-x SW TEMP is the specific temperature of the chilled water leaving the evaporator of chiller x.
 - (2) CHWL-x SW TEMP is the combined temperature of the chilled water leaving all the chillers on chilled water loop x.
 - (3) CWL-x SW TEMP is the combined temperature of the condenser water leaving all the cooling towers on condensing water loop x.
 - (4) CH-x COND RW TEMP is the temperature of the water entering the condensers of CH-x.
- H. For air-side systems (e.g. AC units, AHUs, VAV boxes, etc.) receiving chilled or hot water, the chilled water entering the system shall use “CHWS” and the hot water entering shall use “HHWS”. The chilled water leaving the system shall use “CHWR” and hot water leaving shall use “HHWR”.

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For example, the temperature of the hot water entering AHU-x would be named AHU-x HHWS TEMP.

- I. Alarm names shall follow the standard point naming convention including appropriate Point Attribute and Alarm Modifiers listed in the tables herein.
 - (1) Alarms for the entire system or equipment should use the appropriate name and add ALARM to the end. Specific point names should refer to the specific point.
 - (2) The abbreviation for High Limit (HL) and Low Limit (LL) shall be used for Event and Alarm points only. The abbreviation for minimum (MIN) and maximum (MAX) will be used for all other points and setpoints to designate the minimum and maximum values.
 - (3) Typical Alarm Modifiers are included Table 1.11 I.
- J. Trend names shall follow the standard point naming convention including appropriate Point Attribute Modifiers. In addition, the point ID being trended shall be added in parenthesis at the end of the name. For example, a trend of the supply air temperature for AHU-x that is collecting data from input AI2 would be given the name “AHU-x SA TEMP (AI2)”
 - (1) Zone level equipment (e.g. VAV boxes, Fan Coil Units) receiving air from a central air handling unit will have the standard name preceded by the air handling unit name without the dash (e.g. Acx VAV-x-xx).
- K. Multi-Trend names shall follow the SYSTEM and EQUIPMENT point naming conventions
- L. POINT NAMING CONVENTION
 - (1) System Attribute
 - (2) Equipment Attribute
 - a) Equipment Attribute Modifier
 - (3) Point Attribute
 - a) Point Attribute Modifier

1.09 POINT DESCRIPTION FIELD

- A. The description field shall include a description for all points that are used in a sequence of operation and for alarms and events.
- B. Point Description Field shall include, but not limited to, the following:
 - (1) Zone or room number unit information.
 - (2) Approximate location of zone temperature sensor. For example, near Room 106.
 - (3) Information on calculation method, BDE or floating point, direct feedback, type of object etc.
 - (4) Shall include a full point name. No acronyms or abbreviation are permitted except for VAV. For example, CH01_CHWST is Chiller #1 Chilled Water Supply Temperature.
 - (5) Alarm description shall include general information about the alarm and its alarm limits.

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1.10 STANDARD ATTRIBUTES: ABBREVIATIONS, ACRONYMS, AND NAMES

A. GEOGRAPHIC LOCATION ATTRIBUTES

DESCRIPTION	ATTRIBUTE
East County	EC
North County	NC
South County	SC

B. BUILDING ATTRIBUTES

DESCRIPTION	ATTRIBUTE
165 13 th Street Parking Garage	ALCO PARK
A Street Homeless Shelter	A ST SHELTER
Administration Building	ADMIN
Castro Valley Library	CVL
East County Hall of Justice	ECHOJ
Environmental Health Head Quarters	EH-HQ
Family Justice Center	FJC
Glenn Dyer Detention Facility	GDDF
Heavy Equipment Repair Building	HERB
Information Technology Department	ITD
Juvenile Justice Center	JJC
Lakeside Building	LAKESIDE
Law Library	LAW LIB
Madison Building	MADISON
North County Self Sufficiency Center	NCSCC
Office of Emergency Services	OES
Peralta Oaks	PERALTA OAKS
Rene C. Davidson Courthouse	RCD
San Lorenzo Library	SAN LORENZO LIBRARY
Santa Rita Jail	SRJ
Wiley Manuel Courthouse	WMC

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C. AREA ATTRIBUTES

DESCRIPTION	ATTRIBUTE
Basement	BASEMENT
Building	BLDG
Floor	FLOOR
Global	GLOBAL
Intermediate Distribution Frame	IDF
Main Distribution Frame	MDF
Penthouse	PENTHOUSE
Room	ROOM
Zone	ZONE

D. SYSTEM ATTRIBUTES

DESCRIPTION	ATTRIBUTE
Air Conditioning	AC
Air Handler Unit	AHU
Air Source Heat Pump	ASHP
Chemical Feed System	CHEM FEED
Chilled Water Loop	CHWL
Compressed Air System	COMPRESSED AIR
Computer Room Air Conditioner	CRAC
Computer Room Air Handler	CRAH
Condenser Water Loop	CWL
Constant Air Volume	CAV
Dual-Duct Air Handler	DDAHU
Domestic Hot Water Loop	DHWL
Energy Recovery Ventilator	ERV
Fan Coil Unit	FCU
Glycol System	GLYCOL
Heating Hot Water Loop	HHWL
Heating Ventilator	HV
Lighting	LTG
Make-Up Air Unit	MAU

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Mixing Box	MB
Multi-Zone Air Handler	MZAHU
Packaged Air Conditioner	PTAC
Steam Loop	STML
Tempered Water Heater	TWH
Tempered Water Loop	TWL
Under Floor Variable Volume Box	UFVAV
Variable Air Volume	VAV
Variable Refrigerant Volume	VRV
Water Heater	WH
Water Source Heat Pump	WSHP

E. EQUIPMENT ATTRIBUTES

DESCRIPTION	ATTRIBUTE
Blowdown Valve	BLOWDOWN-VLV
Boiler	BLR
Burner	BURNER
Burner Fan	BURNER FAN
Bypass Damper	BYPASS DAMPER
Bypass Valve	BYPASS VLV
Chilled Water Valve	CHW VLV
Chiller	CH
Circuit	CIRCUIT
Cold-Deck	CD
Compressor	COMP
Condensate Pump	CONDENSATE PUMP
Condenser on a chiller	COND
Condenser Unit on AC Units	CU
Condenser Unit Compressor	CU COMP
Condenser Unit Fan	CUF
Condenser Unit Valve	CU VLV
Condenser Water Pump	CWP
Cooling Tower	CT
Cooling Tower Fan	CTF

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Cooling Valve	CLG VLV
Draft Damper (Exhaust Flue)	DRAFT DAMPER
Draft Fan (Exhaust Flue)	DF
Economizer	ECONOMIZER
Electric Unit Heater	EUH
Electrically Commutated Motor	ECM
Evaporator	EVAP
Exhaust Air Damper	EA DAMPER
Exhaust Fan	EF
Fan	FAN
Filter	FILTER
Final Filter	FINAL FILTER
Fire Damper	FIRE DAMPER
Flue Draft Fan	FLUE DF
Fluid Cooler Fan	FCF
Gas Valve	GAS VLV
Heat Exchanger	HEX
Heating Valve	HTG VLV
Hot-Deck	HD
Inlet Vane	IV
Isolation Valve	ISO VLV
Mixed Air Damper	MA DAMPER
Outside Air Damper	OA DAMPER
Pre-Filter	PRE-FILTER
Primary Chilled Water Pump	PCHWP
Primary Condenser Water Pump	PCWP
Primary Heating Hot Water Pump	PHHWP
Primary Tempered Water Pump	PTWP
Return Air Damper	RA DAMPER
Reversing Valve	REV VLV
Return Fan	RF
Sash	SASH
Secondary Chilled Water Pump	SCHWP
Secondary Condenser Water Pump	SCWP
Secondary Heating Hot Water Pump	SHHWP

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Secondary Tempered Water Pump	STWP
Smoke Damper	SMK DAMPER
Sump Pump	SUMP PUMP
Supply Air Damper	SA DAMPER
Supply Fan	SF
Tempered Water Heater	TWH
Tempered Water Pump	TWP
Tempered Water Valve	TW VLV
Transfer Fan	TF
Ventilation Fan	VF
Water Heater	WH
Water Heater Blower Fan	WH BF
Zone	ZONE
Zone Damper	ZONE DAMPER
Zone Thermostat	ZONE TSTAT

F. EQUIPMENT ATTRIBUTE MODIFIERS

DESCRIPTION	ATTRIBUTE
Discharge Damper	DD
Inlet Vane	IV
Meter	METER
Sensor	SENSOR
Variable Frequency Drive	VFD

G. POINT ATTRIBUTES

DESCRIPTION	ATTRIBUTE
Acid or Alkaline Measurement	PH
Afterhours Call	AFTERHOURS CALL
Air Change Per Hour	ACH
Blowdown Cycles	BLOWDOWN CYCLES
Carbon Dioxide PPM	CO2
Carbon Monoxide PPM	CO
Closed	CLOSED

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Cooling	CLG
Cooling Capacity	CLG CAPACITY
Cooling Load	CLG LOAD
Cooling Supply Air Flow	CLG SA FLOW
Current	CURRENT
Deadband	DEADBAND
Energy	ENERGY
Exhaust Air Duct Static Pressure	EA DUCT STAT PRES
Exhaust Air Flow	EA FLOW
Exhaust Air Temperature	EA TEMP
External Stop STS	EXTERNAL STOP STS
Equipment Failure	FAILURE
Feed Water Flow	FW FLOW
Feed Water Temperature	FW TEMP
Fire Alarm	FIRE ALARM
Fire Rate	FIRE RATE
Flue Gas Pressure	FG PRES
Flue Gas Temperature	FG TEMP
Frequency	FREQ
Frost Protection Status	FROST PROTECTION STS
Gas Pressure	GAS PRES
Heating	HTG
Heating Load	HTG LOAD
Heating Requests	HTG REQUESTS
Heating Supply Airflow	HTG SA FLOW
Humidity	HUMD
In Auto Mode	AUTO
In BAS Control	BAS CONTROL
In Local Control	LOCAL CONTROL
Instantaneous Demand	DEMAND
Instantaneous Demand Limit	DEMAND LIMIT
Instantaneous Demand Limit Level	DEMAND LMT LVL
Load	LOAD
In Local Control	LOCAL CONTROL STS
Level	LVL

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Load	LOAD
Lockout	LOCKOUT
Low Water Cut-Out	LOW WATER CUT-OUT
Make-Up Water Flow	MUW FLOW
Mixed Air Temperature	MA TEMP
Moring Ventilation Purge	MORNING VENILATION PURGE
Morning Warmup	MORNING WARMUP
Number of Starts Per Hour	STARTS PER HOUR
Occupied	OCC
Occupied or Unoccupied	OCC/UNOCC
Off	OFF
Oil Pressure	OIL PRES
Oil Temperature	OIL TEMP
On	ON
On or Off	ON/OFF
Open	OPEN
Open or Closed	OPEN/CLOSED
Outside Air Flow	OA FLOW
Outside Air Humidity	OA HUMD
Outside Air Temperature	OA TEMP
Override	OVRR
Oxidation Reduction Potential	ORP
Position	POS
Pressure	PRES
Pressure Differential	PRES DIFF
Purge Cycle	PURGE
Refrigerant Leak	REFGN LEAK
Reset	RESET
Return Air Carbon Dioxide	RA CO2
Return Air Flow	RA FLOW
Return Air Humidity	RA HUMD
Return Air Duct Static Pressure	RA DUCT STAT PRES
Return Air Temperature	RA TEMP
Return Air Wetbulb Temperature	RA WETBLB TEMP
Return Glycol Water Flow	RGW FLOW

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Return Glycol Water Pressure	RGW PRES
Return Glycol Water Temperature	RGW TEMP
Return Water Flow	RW FLOW
Return Water Pressure	RW PRES
Return Water Temperature	RW TEMP
Runtime	RUNTIME
Saturated Temperature (Condensing)	SATURATED TEMP
Speed	SPEED
Stage Down	STAGE DWN
Stage Up	STAGE UP
Start/Stop	ON/OFF
Static Pressure	STAT PRES
Static Pressure Requests	STAT PRES REQUESTS
Steam Pressure	STEAM PRES
Steam Temperature	STM TEMP
Supply Air Flow	SA FLOW
Supply Air Flow Request	SA FLOW REQUEST
Supply Air Humidity	SA HUMD
Supply Air Duct Static Pressure	SA DUCT STAT PRES
Supply Air Temperature	SA TEMP
Supply Glycol Water Flow	SGW FLOW
Supply Glycol Water Pressure	SGW PRES
Supply Glycol Water Temperature	SGW TEMP
Supply Water Flow	SW FLOW
Supply Water Pressure	SW PRES
Supply Water Temperature	SW TEMP
Temperature	TEMP
Temperature Difference	TEMP DIFF
Total Dissolved Solids	TDS
Unoccupied	UNOCC
VAV Factor	KFACTOR
Ventilation Only	VENTILATION
Voltage	VOLTAGE
Water Level	WATER LVL
Wetbulb Temperature	WETBLB TEMP

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H. POINT ATTRIBUTE MODIFIERS

2	DESCRIPTION	ATTRIBUTE
	Command – Binary or Multi-state Output	CMD
	Enable – Binary or Multi-state Output	ENABLE
	High Limit for Alarms	HL
	Low Limit for Alarms	LL
	Maximum Value or Setpoint	MAX
	Minimum Value or Setpoint	MIN
	Operating Modes for Multi-State Inputs	MODE
	Percent	%
	Setpoint – Analog Output	SP
	Status – Binary Input	STS
	Totalization Calculations	TOTAL

I. ALARM MODIFIERS

DESCRIPTION	ATTRIBUTE
Communication Alarm	COMM ALARM
Dirty Alarm	DIRTY ALARM
General System or Equipment Alarm	ALARM
Hand of Auto Switch Alarm	HOA ALARM
High Limit Alarm	HL ALARM
In Manual Alarm	MANUAL ALARM
Low Limit for Alarm	LL ALARM
Overflow Alarm	OVERFLOW ALARM
Sensor Alarm	SENSOR ALARM
Short Cycle Alarm	SHORT CYCLE ALARM
Smoke Alarm	SMOKE ALARM
Trip Alarm	TRIP ALARM

PART 2 – PRODUCTS

A. NOT USED.

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PART 3 - EXECUTION

3.01 EXAMPLES

A. SITE EXAMPLE:

- (1) North County Rene C. Davidson Courthouse
 - a) NC RCD

B. SYTEM EXAMPLES:

- (1) Standard: System Attribute and Point Attribute
- (2) Example #1 Supply Water Temperature and Setpoint for Chiller 1
 - a) CH-1 SW TEMP
 - b) CH-1 SW TEMP SP
- (3) Example #2 Return Air CO2 and Setpoint for AHU-1
 - c) AHU-1 SA TEMP
 - d) AHU-1 SA TEMP SP
- (4) Example #3 Lighting Status for 1st Floor, Zone 12, and Room 235
 - e) LTG FLOOR 1 ON/OFF STS
 - f) LTG ZONE 12 ON/OFF STS
 - g) LTG ROOM 235 ON/OFF STS

C. EQUIPMENT EXAMPLE:

- (1) Standard: Equipment Attribute and Point Attribute
- (2) Example #1 Supply Air Flow and Setpoint for Variable Air Volume Box on 1st Floor
 - a) VAV 1-1 SA FLOW
 - b) VAV 1-1 SA FLOW SP
- (3) Example #2 Supply Air Temperature and Setpoint for Variable Air Volume Box with reheat on 3rd Floor
 - c) VAV 1-1-RH SA TEMP
 - d) VAV 1-1-RH SA TEMP SP

D. ALARM EXAMPLE:

- (1) North County Rene C. Davidson Courthouse Chiller #1 High Supply Water Temperature
 - a) CH-1 SW TEMP HL ALARM

VI.D GRAPHICS DESIGN CONVENTION



DOCUMENT 23 09 XX

GRAPHICS DESIGN CONVENTION

1.01 INTRODUCTION

The Board of Supervisors has a long-standing commitment to energy conservation, carbon reduction, and green building practices, adopting a Green Building Ordinance for **County Facilities (R-2003-63) in 2003 and the Resolution Endorsing the Declaration of a Climate Emergency (R-2019-375) in 2019** that commits the County to “aggressively pursue emission reduction strategies in its own operations and invest in resilient service delivery.” Installing advanced, user-friendly building automation systems (BAS) at County facilities significantly enhances the opportunities to minimize inefficient control practices and reduce energy use, which supports the County’s commitment to reduce our greenhouse gas emissions and improve the overall quality of the spaces and buildings used by staff and the public.

Purpose: The County of Alameda created control system graphics design convention to guide the design and construction professionals to implement a consistent and user-friendly graphic design for all new construction, renovations, and retrofit work. Control system pages, graphics and descriptions are critical in terms of allowing the staff involved with operating the building to quickly interpret what is going on with the control system and respond appropriately to minimize operating issues.

These guidelines are not intended for use, in whole or in part, as a specification, attachment, or exhibit. Do not copy the guidelines verbatim in specifications or in notes on drawings unless approved by the owner. Where differences between this document and other specifications, guidelines, and standards occur, this guideline shall be applied. Refer questions and comments regarding the content and use of these documents to the Alameda County Project Manager or representative.

1.02 DEFINITIONS AND KEY TERMS

- A. **Owner is defined as...**
- B. The terms “Building Automation Systems (BAS)”, “Controls” and “Energy Management Controls Systems (EMCS) are used interchangeably.
- C. Default manufacture naming is not permitted.
- D. Input and output (IO) shall include physical inputs and outputs that are wired to a controller and points not wired to a controller often called software, virtual, or values will be programmed as virtual or software points.
- E. Systems are defined as any Equipment (per 1.02G) that is controlled as a group. Examples include, but are not limited to, the following:
 - (1) Chilled Water Systems: chillers, heat exchangers, valves, pumps, VFDs, etc.
 - (2) Condenser Water Systems: cooling towers, heat exchangers, fans, pumps, valves, VFDs, etc.
 - (3) Hot Water Systems: boilers, heat exchangers, dampers, valves, pumps, VFDs, etc.
 - (4) Air Handling Units: dampers, heating coils, cooling coils, valves, fans, VFDs, etc.
 - (5) Zone-HVAC (e.g. VAVs, FCUs, etc.): dampers, compressors, heating coils, cooling coils, valves, fans, VFDs, etc.

- F. Other system types include, but are not limited to: compressed air, onsite energy storage (e.g. batteries and thermal energy storage), onsite energy generation (e.g. photovoltaic, solar thermal, fuel cells, etc.), microgrids, process, refrigeration, sanitary and vacuum systems.
- G. Systems serving multiple buildings are defined as “campus” systems that shall follow the requirements for such systems described in this guideline.
- H. Equipment is defined as the individual components of a system operating together to execute the sequence of operation. Equipment includes, but is not limited to, the following: boilers, chillers, heat exchangers, compressors, cooling towers, dampers, fans, generators, humidifiers, heaters, lighting, motors, plug loads, pumps, valves and VFDs.

1.03 GENERAL CONSIDERATIONS

- A. This document outlines the general requirements and standards for graphics and presenting controls systems equipment, networks and points, including, but not limited to, all ancillary equipment and third-party devices for both new and retrofit installations.

Customized graphics shall show the project building(s) and their floor plans, mechanical, and electrical equipment, flow and control diagrams, and other relevant features including:

- (1) All associated input, output, and virtual objects (e.g., temperature and pressure set points) listed in the Sequence of Operation shall be shown on the schematic diagrams on the graphic screens **and bound to the database.**
 - (2) In addition to points used directly to implement the sequence of operation, points used to evaluate operation and performance (e.g. alarms, flags, efficiencies, etc.) of the various building systems shall be included on graphics pages as outlined in this section.
 - (3) Real-time value of objects updated on the display of each graphic shall update automatically.
- B. All control devices, including third-party devices, shall be accessible from the graphics.
 - C. Provide operators complete access to control system and graphics via web browser. No special software other than a web browser can be required to access graphics, point displays, and trends.
 - D. Penetration: The graphic interface to consistently apply a convention whereby a left-click to always penetrate to more detailed information. The text windows to represent the deepest level of penetration. A right-click to always produce a menu of options that are specific to the item selected.
 - E. Navigation: Graphics organized to provide a "branching structure" that allows an operator to move from a "macro view" to a "micro view" and return. These links to other associated graphics, or allow a return to a previous macro view, provided and arranged horizontally along the bottom of each graphic screen. From left to right, **the graphic links as follows: site/building map, building/trailer floor plans, and major mechanical systems at each building. Pop-up right click menus provided as needed on the lower button bar to allow for uncluttered navigation.**
 - F. **Clutter Minimization: Each graphic to have separate check boxes in the lower right corner that show/hide set points, alarms/safeties, and devices/equipment.**
 - G. Templates: To the maximum extent possible, use standard graphics as templates to provide a consistent look throughout the interface.
 - H. Color Scheme: The graphics to use dynamic color changes to communicate equipment type, or object status consistent with the graphics color legend.
 - I. Symbols and Animations: Fans, pumps, dampers, coils, and generation equipment to be dynamic symbols indicating rotation, state, or position, movement, flow, etc.
 - J. Macros: When macros are used to add functionality to the graphics, detailed documentation must be

- provided.
- K. **Configure Mode: Access to “Configure Mode” for editing of the graphics password protected to prevent unauthorized changes to the graphics. This password supplied to the appropriate personnel.**
 - L. Graphics Version: Graphics provided in the most current format available at time of control system programming.
 - M. Graphics Library shall be furnished with standard HVAC equipment graphics and include standard symbols for fans, pumps, coils, valves, piping, dampers, and ductwork.
 - N. Custom Graphics. Provide custom graphics generation package.
 - O. Points and graphics checked for the proper binding and graphic programming, settings to ensure that the correct system, location, point values and dynamics are shown in the proper location and rotate in the proper directions.
 - P. Provide operators ability to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. Input, output, and value object types in the system may be logged. Provide operations password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
 - Q. Web Page Data Display: Web page graphics shown on browser to be replicas of the BAS displays. User to need no additional training to understand the information presented on Web pages when compared to what is shown on BAS displays. Web page displays to include:
 - (1) Animation just as BAS displays. Fans to turn, pilot lights to blink, and coils to change colors, and so on.
 - (2) Real-time data shown on browser Web pages that is directly gathered via the BACnet network and automatically updated on browser
 - (3) Automatic data refresh as changes are detected without any user action or re-drawing of the complete display.
 - (4) User to be able to change data from browser Web page to ??? if the user is logged on with the appropriate password.
 - R. Web Page Display Functionality: Web page graphics to retain same functionality as BAS displays.
 - (1) Clicking on a button or typing in a new value to change digital data.
 - (2) Using pull-down menus or typing in a new value to change analog data.
 - (3) Data displays navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display.
 - (4) Alternatively, the standard back and forward buttons of the browser can be used for display navigation.
 - S. Web Page Generation: Web pages generated automatically from the BAS displays that reside on the BAS server. User to access Web-page host via the network and initiate a web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access via any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages will not be considered.
 - T. The standard point naming convention shall be used for all points referenced in the sequence of operation or other system functions.
 - U. The naming convention shall be consistent throughout all documents, drawings, specifications, equipment & wire labeling, testing, commissioning & training documents, programming and graphics.
 - V. Any graphic, control object, tag or point that is not represented in this document or the Point Naming

Convention must be submitted to the Owner for review and approval. A response will be generated identifying the name that shall be used for the application. If the supplied name is not currently represented in the standard document, it may be added.

- W. Projects with existing campus and/or building controls systems that will not be replaced, may replicate the graphics used in the existing BAS screens with approval by Owner.
- X. Modifications, variance, or changes that deviate from this convention shall be submitted for review and approval by Owner during the project.
- Y. After graphics have been accepted, provide, **on a CD ROM in an agreed upon file structure**. If the graphics have active-x controls or other files that must be placed outside the graphics folder structure a set-up program provided on the disk to place the files in the correct locations.

1.04 GENERAL GRAPHICS CONVENTION RULES

- A. In general, graphics shall include the following pages:
 - (1) Campus Home (as required)
 - (2) System Layout (as required)
 - (3) Building Home (each building)
 - (4) Building Floorplan (each building)
 - (5) System Schematic (each system)
 - (6) Stand-alone Equipment Schematics (as required)
 - (7) Settings and Alarms (each System and Stand-alone Equipment Schematic)
 - (8) Performance (each System and Stand-alone Equipment Schematic)Individual screens shall be provided for each.
- B. All pages, though not pop-ups, will include the following:
 - (1) Links to the print function
 - (2) Displays of the date, time, outdoor air temperature and outdoor air humidity from the closest available weather station displayed in the upper left corner
 - (3) Links to summary pages for Schedules, Alarms and the Controls Submittals.
 - (4) Links at the top to any legends that are specific to that equipment or system.
- C. All control and field devices shown in the graphics shall be identified by the BAS software point associated with the value measured. Examples include: damper position, temperature, humidity and flow. Hardware names for the physical device shall not be used for any of the points on the graphics.
- D. Graphics to provide visual means of alarm indication and troubleshooting with the following functionality:
 - (1) The alarm dialog box to always become the top dialog box regardless of the application(s), currently running.
 - (2) Alarm text and color of information tags that describe each object and alarm value to be consistent with a graphics color legend provided.
 - (3) System to provide log of alarm messages that can be accessed through a link on the Home Page.
 - (4) Each analog object to have both high and low alarm limits that are displayed on the Settings and Alarm pages and linked to the point.

- (5) Alarms must be able to be automatically and manually disabled from the graphics pages.

1.05 **STANDARD HOME PAGE DESIGN**

- A. Typically, a campus or building graphic with a photograph of the campus or building will serve as the Home page as directed by the Owner. The home page shall include tabs and pull-down menus as defined herein.
- B. Each Campus Page shall include an illustration or photo of the entire campus. In addition to the items listed in Section 1.04B, each Campus Home page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page
 - (2) Buildings tab at the top of the page with a dropdown menu listing each building on the campus with links to each Building Home page as described in part C
 - (3) System Layout tab at the top of the page with a dropdown menu that lists each multi-building system type (e.g. chilled water, hot water, etc.) for the campus with links to the schematic of each of those systems.

The dropdown menu shall not include the Settings and Alarms or Performance pages, which shall have a link in the Schematic pages per sections 1.07 and 1.08.

- C. Each Building Page shall include an illustration or photo of the building. In addition to the items listed in Section 1.04B, each Building Home page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with links to the respective schematic. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.
 - (4) Stand-Alone Equipment tab that links to specific equipment that is not part of a building system (e.g. Toilet Exhaust Fans).

The dropdown menus shall not include the Settings and Alarms or the Performance pages, which shall have a link in the Schematic pages per sections 1.07 and 1.08.

- D. Points to be included on the home page
 - (1) Date and time
 - (2) Outside air temperature
 - (3) Outside air humidity

1.06 **STANDARD FLOOR PLAN / SYSTEM LAYOUT PAGE DESIGN**

- A. Each Floor Plan page shall include an illustration the area represented. In addition to the items listed in Section 1.04B, each page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with

links to the respective schematic. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.

- B. Floor plans of each floor showing all equipment, temperature sensors, pressure sensors, temperature control zones, heating/cooling zones, ventilation zones, and supply air zones identified. Rooms grouped on a graphic only to the extent that detailed and complete sensing information can be comfortably viewed by an operator and the bound points updated in less than 10 seconds.
- C. Each zone to have a temperature symbol that changes color over the range from low (blue) through normal (green) to high (red) and indicate an alarm (flashing red). The zone temperature and or pressure symbol(s) to be a link to a zone control pop-up graphic. Individual floor plan graphics to provide links to related mechanical systems. The mechanical room plan graphics to show the relative location of, and provide links to, either the equipment pop-up or flow and control graphic for mechanical equipment monitored or controlled by the BAS.
- D. Equipment will be shown on individual floor plans that illustrate the physical location with a link to the System Schematic page for the specific equipment.
- E. In general, floor plans shall include no more than a single floor in each building, though each floor may need to be further divided into multiple sections for a large amount of equipment.
- F. Points to be included on the floorplan pages.
 - (1) Date and time
 - (2) Outside air temperature and humidity
 - (3) Zone temperatures, humidity, and pressure
 - (4) Zone alarms
- G. For very large systems that cannot be effectively illustrated with individual floor plans (e.g. Microgrids, multi-building water loops, etc.) a System Layout graphic shall be created that shows the entire area served by the system. The layout shall include all the equipment (chillers, boilers, pumps, heat exchangers, storage tanks, etc.) associated with the system with links to the System Schematic page(s).
- H. Each System Layout Page shall include an illustration of the system. In addition to the items listed in Section 1.04B, each System Layout page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Campus page tab at the top of the page with a dropdown menu listing each building on the campus with links to each Building Home page as described in part C
 - (3) System Layout tabs at the top of the page with a dropdown menu that lists each multi-building system type (e.g. chilled water, hot water, etc.) for the campus with links to the schematic of each of those systems.

The dropdown menu shall not include the Settings and Alarms or Performance pages, which shall have a link in the Schematic pages per sections 1.07 and 1.08.

- I. Points to be included on the layout page(s).
 - (1) Date and time
 - (2) Outside air temperature and humidity
 - (3) System enable command and status.
 - (4) System setpoints and actual values of control points.
 - (5) Equipment start/stop command and status.

- (6) Equipment setpoints and actual values of control points.
- (7) Status and setpoint alarms.

J. Other items?

1.07 STANDARD SYSTEM SCHEMATIC PAGE DESIGN

- A. Each System Schematic page shall have a schematic that accurately represents the system and includes the critical points for that system. In addition to the items listed in Section 1.04B, each page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with links to the respective schematic. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.
- B. For central plant systems, each page shall represent an individual water loop (primary chilled water, secondary chilled water, hot water, condenser water, etc.).
- C. All system components (chillers, boilers, pumps, fans, dampers, valves, etc.) shall be included on the schematic page with notes concerning equipment location. For example, a note identifying the location shall be added to the graphic for all the equipment. If some interconnected equipment is in an entirely different area, e.g. exhaust fans for an air handling unit, the equipment shall be displayed on the air handling unit's schematic page with the equipment location noted underneath that equipment.
- D. Schematics to include all associated equipment and field devices such as temperature sensors, pressure sensors, flow sensors dampers, and refrigeration leak detectors.
- E. Pop-up graphics provided for each zone control system showing a flow diagram and related monitoring and control points and system parameters. Pop-up graphics provided for each piece of equipment that is not shown on a flow and control graphic.
- F. Flow and control diagrams for each system. The flow and control graphics to have parameters grouped in the lower portion of the graphics. Standard equipment graphics used. System flow and control graphics displayed in a general left to right flow or loop arrangement. Return and exhaust air flow shown on top and return water shown on the bottom of the graphic.
- G. Individual equipment/component screens showing sensing and control information available for each device provided.
- H. Points to be included on the floorplan / layout pages.
 - (1) Date and time
 - (2) Outside air temperature and humidity
 - (3) System enable command and status.
 - (4) System setpoints and actual values of control points.
 - (5) Equipment start/stop command and status.
 - (6) Equipment setpoints and actual values of control points.
 - (7) Status and setpoint alarms.
- I. Page buttons that link to the Settings and Alarm, and Performance pages for system represented.

1.08 **STANDARD STAND-ALONE EQUIPMENT PAGE DESIGN**

- A. Individual equipment that is not part of a larger system (e.g. bathroom exhaust fans) can be combined with other stand-alone equipment on a single page.
- B. Each Stand-Alone Equipment page shall have a schematic that accurately represents the equipment and includes the critical points for that system. In addition to the items listed in Section 1.04B, each page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with links to the schematic of each system in the list. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.
- C. Schematics to include all associated field devices such as temperature sensors, pressure sensors, flow sensors dampers, and refrigeration leak detectors.
- D. Pop-up graphics provided for each zone control system showing a flow diagram and related monitoring and control points and system parameters. Pop-up graphics provided for each piece of equipment that is not shown on a flow and control graphic.
- E. Flow and control diagrams for each equipment. The flow and control graphics to have parameters grouped in the lower portion of the graphics. Standard equipment graphics used. Equipment flow and control graphics displayed in a general left to right flow or loop arrangement. Return and exhaust air flow shown on top and return water shown on the bottom of the graphic.
- F. Points to be included on the stand-alone equipment pages
 - (1) Date and time
 - (2) Outside air temperature and humidity
 - (3) Equipment start/stop command and status
 - (4) Equipment setpoints and actual values of control points
 - (5) Status and setpoint alarms
- G. Page buttons that link to the Settings and Alarm, and Performance pages for equipment represented. The ‘Settings and Alarms’ and ‘Performance’ pages shall include all individual equipment represented in each Stand-Alone Equipment page.

1.09 **STANDARD SETTINGS AND ALARMS PAGE DESIGN**

- A. Each system shall have one or more pages that provide summary tables for the settings and alarms of the various equipment (fans, pumps, etc.) comprising the system represented. The tables will include all the setting and alarm points for the equipment. For central plant systems, each page shall represent an individual water loop (chilled water, hot water, condenser water, primary loops, secondary loops, etc.)
- B. Settings and Alarm pages shall use tables to display information.
 - (1) Large systems (chilled water, hot water. AHU’s) shall have tables grouped by equipment
 - (2) Small systems (VAV, FCUs, etc.) and stand-alone equipment shall be combined into one table listing all the equipment together.

- C. In addition to the items listed in Section 1.04B, each page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with links to the respective schematic. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.
- D. The following points shall be included:
 - (1) Date and Time.
 - (2) Outside air temperature and humidity.
 - (3) Current operating mode of the system.
 - (1) Equipment lead, lag assignments.
 - (2) Runtime hours of the system and equipment
 - (3) All setpoints for the system and equipment
 - (4) All Alarms for the equipment within the system
- E. Other?

1.10 STANDARD PERFORMANCE PAGE DESIGN

- A. Each system shall have one or more pages that provides summary tables for the actual performance and operating efficiencies of the various equipment (fans, pumps, etc.) comprising the system represented. The tables will include all the operating points (temperature, flow, pressure etc.) and efficiencies for that piece of equipment. For central plant systems, each page shall represent an individual water loop (chilled water, hot water, condenser water, primary loops, secondary loops, etc.)
- B. Performance pages shall use tables to display information.
 - (1) Large systems (chilled water, hot water. AHU's) shall have tables grouped by equipment
 - (2) Small systems (VAV, FCUs, etc.) and stand-alone equipment shall be combined into one table listing all the equipment together.
- C. In addition to the items listed in Section 1.04B, each page will have the following tabs with dropdown menus:
 - (1) Home tab to redirect user the designated BAS home page.
 - (2) Floorplans tab at the top of the page with a dropdown menu listing each floorplan in the building with links to the floorplan pages as described in section 1.06.
 - (3) System tabs at the top of the page for each building system type (e.g. chilled water, hot water, etc.) and additional Stand-Alone Equipment tab(s) with a dropdown menu listing each with links to the respective schematic. Campus systems that serve the building shall also be included in the dropdown menu and identified as a campus system.
- D. Points to be included on the performance pages.
 - (1) Current operating modes
 - (2) Setpoints and values

- (3) Energy use
- (4) Efficiency parameters

E. Other?

1.11 REQUIRED SUBMITTALS

- A. A graphics package illustrating the graphics design to be used must be submitted for review and approval by Owner prior to implementation.
- B. The graphics submittal package to include one example, including an inactive designation of the proposed tabs, links and points, of the following:
 - (1) One Campus page, as necessary
 - (2) One Building page
 - (3) System Layouts, as necessary, for each system type
 - (4) One Floor plan
 - (5) System Schematics for each major system type
 - (6) One Stand-Alone Equipment page
 - (7) One Settings and Alarm page
 - (8) One Performance page
- C. The graphics submittal package shall be part of the 50% design drawing review by the County project manager.

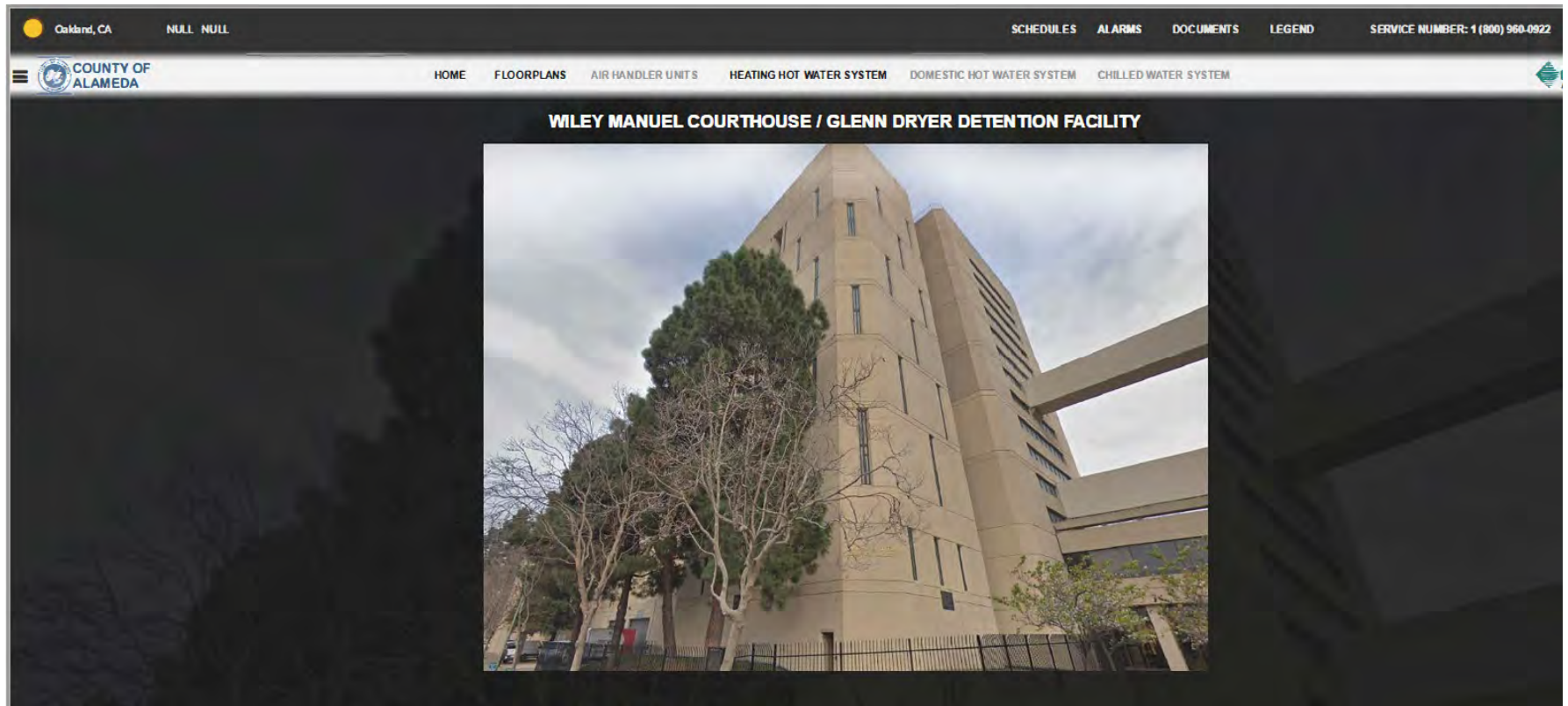
PART 2 – PRODUCTS

- A. NOT USED.

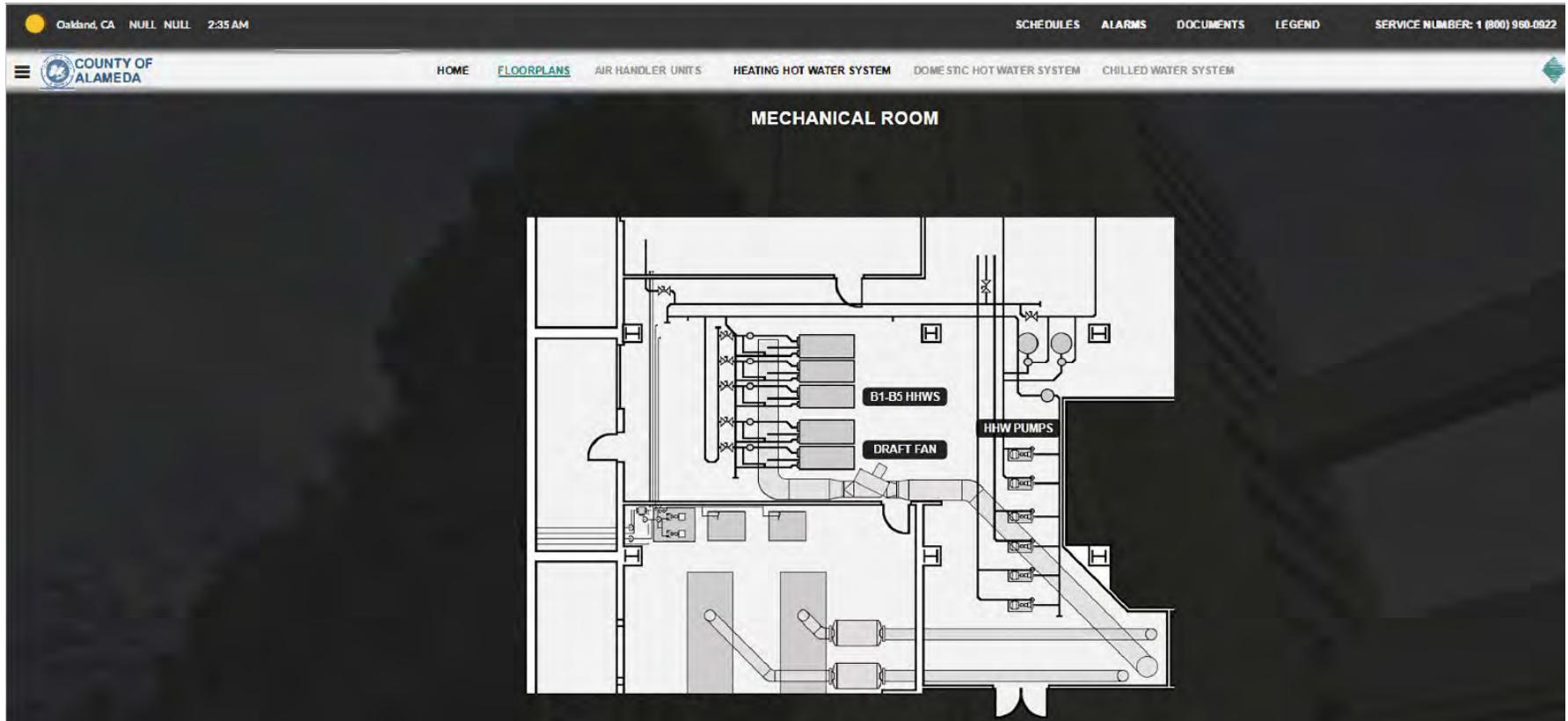
PART 3 - EXECUTION

3.01 EXAMPLES

A. HOME PAGE EXAMPLE:

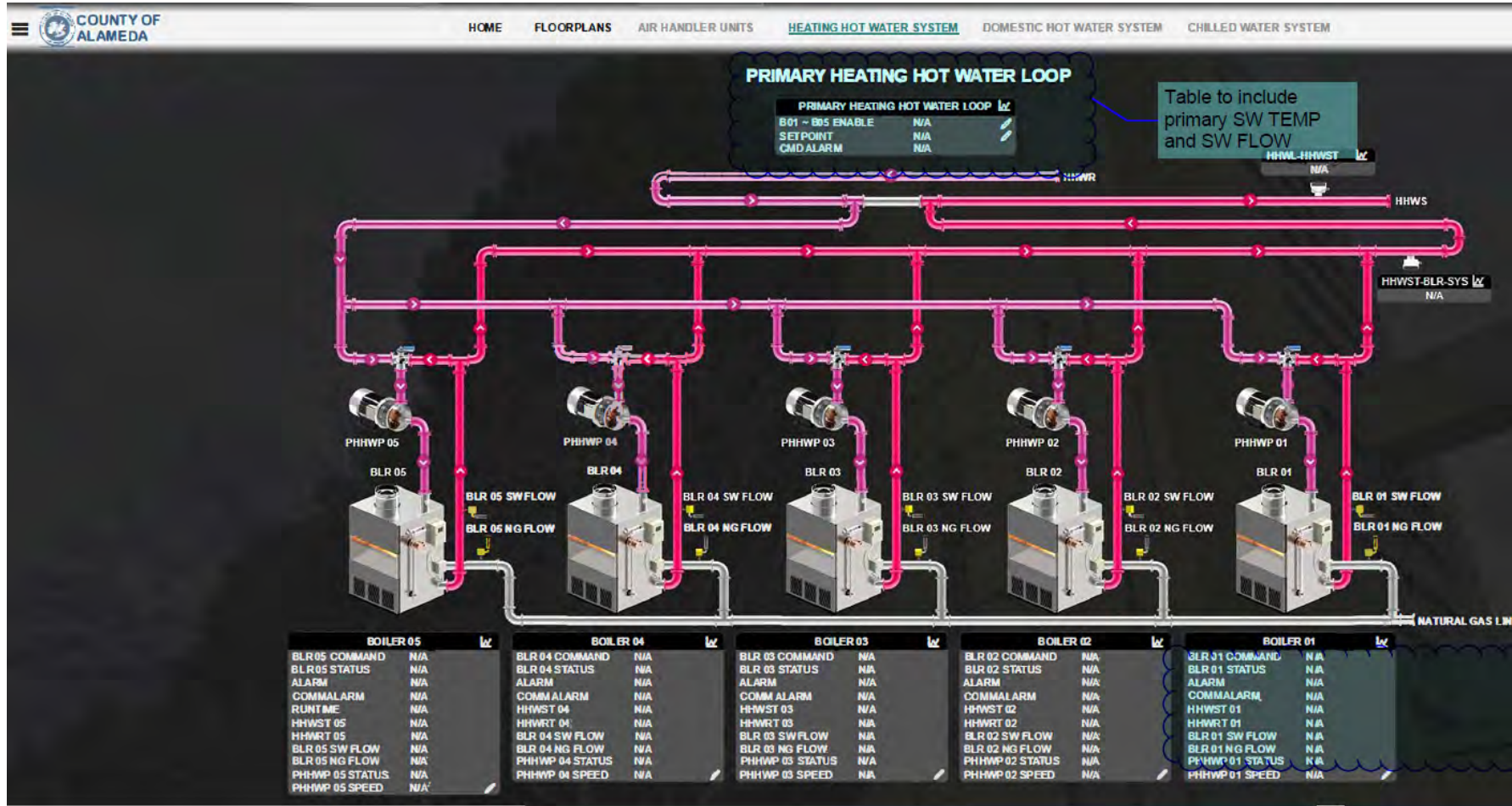


B. FLOOR PLAN PAGE EXAMPLES:

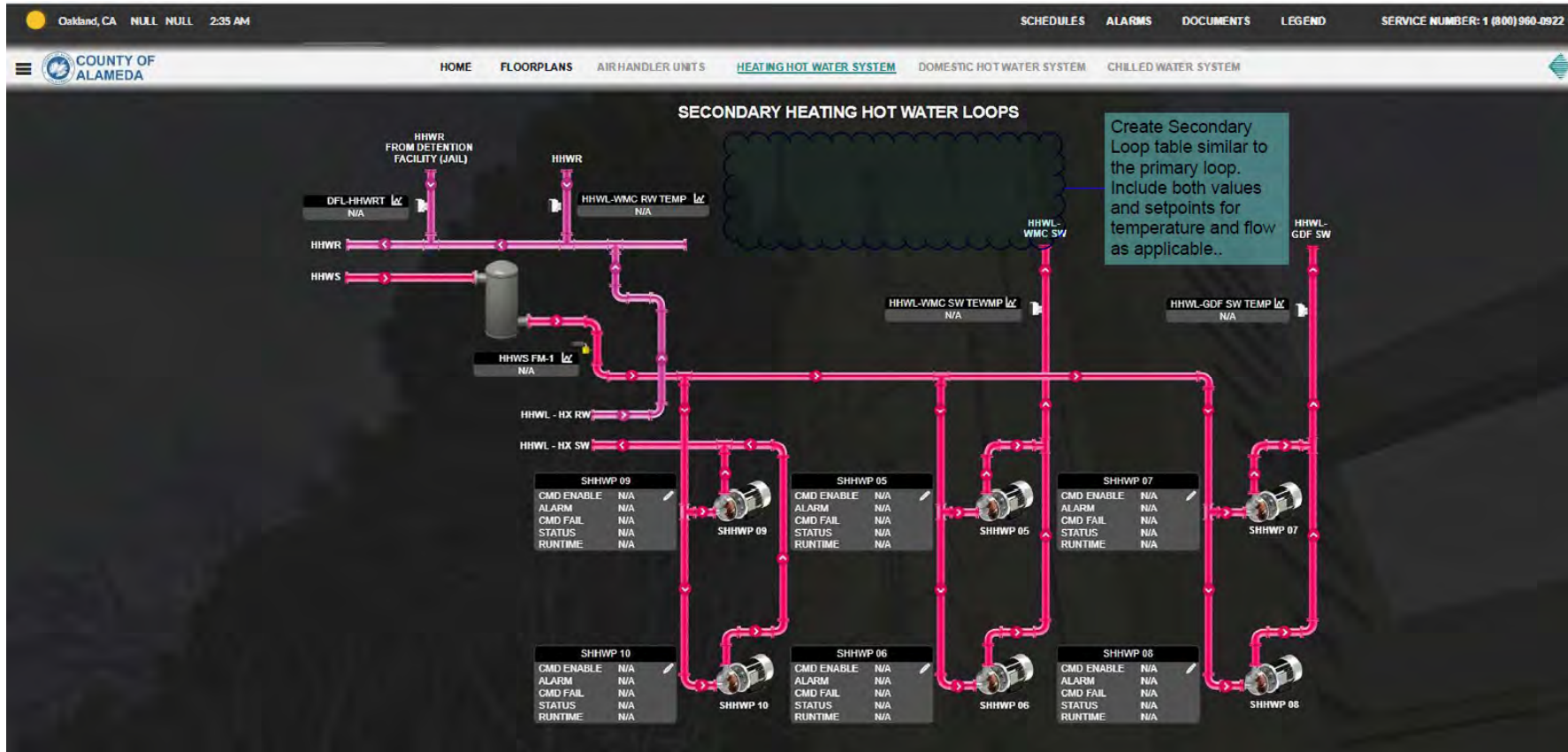


C. SYSTEM SCHEMTAIC PAGE EXAMPLES:

(1) Primary Heating Hot Water Loop



(2) Secondary Heating Hot Water Loop



- (3) Air Handling Unit
TBD

D. SETTINGS AND ALARM PAGE EXAMPLES:

(4) Primary Heating Hot Water Loop

The screenshot displays a control system interface for the Primary Heating Hot Water Loop. The top navigation bar includes 'HOME', 'FLOORPLANS', 'AIR HANDLER UNITS', 'HEATING HOT WATER SYSTEM', 'DOMESTIC HOT WATER SYSTEM', and 'CHILLED WATER SYSTEM'. The main content area is titled 'PRIMARY HEATING HOT WATER LOOP SETTINGS AND ALARM' and is divided into several sections:

- PRIMARY LOOP (HHWL-P) MODE:** A list of settings including MODE (NULL), ACTIVE SYSTEM (NULL), BOILER LEAD (NULL), MODE SHUTDOWN (N/A), SYSTEM ENABLE (N/A), DELAY SPT (N/A), DELAY REM (N/A), DISABLE DELAY SPT (N/A), VLV ENABLE DELAY (N/A), EFF ALARM OFFSET SPT (N/A), BOILER ROTATION SP (N/A), BOILER ROTATION REM (N/A), BLR TIMED ROT ACTIVE (N/A), BOILERS ISO CMD ALARM (N/A), BLRS SW TEMP HL ALARM (N/A), BLRS SW TEMP LL ALARM (N/A), BOILERS ALARM (N/A), and BLRS ENBL CMD ALARM (N/A).
- BOILER 01 (BLR 01) AND PRIMARY PUMP 01 (PHHWP 01):** A list of alarm codes including BLR 01 ALARM (N/A), BLR 01 COMM ALARM (N/A), BLR 01 RUNTIME ALARM (N/A), BLR 01 SW TEMP ALARM (N/A), BLR 01 FLOW ALARM (N/A), BLR 01 RECIRC PUMP ALARM (N/A), BLR 01 FG TEMP ALARM (N/A), BLR 01 CP HAND ALARM (N/A), BLR 01 VFD COMM ALARM (N/A), BLR 01 EFF ALARM (N/A), and BLR 01 CYCLE ALARM (N/A).
- BOILER 02 (BLR 02) AND PRIMARY PUMP 02 (PHHWP 02):** A list of alarm codes including BLR 02 ALARM (N/A), BLR 02 COMM ALARM (N/A), BLR 02 RUNTIME ALARM (N/A), BLR 02 SW TEMP ALARM (N/A), BLR 02 FLOW ALARM (N/A), BLR 02 RECIRC PUMP ALARM (N/A), BLR 02 FG TEMP ALARM (N/A), BLR 02 CP HAND ALARM (N/A), BLR 02 VFD COMM ALARM (N/A), BLR 02 EFF ALARM (N/A), and BLR 02 CYCLE ALARM (N/A).
- BOILER 03 (BLR 03) AND PRIMARY PUMP 03 (PHHWP 03):** A list of alarm codes including BLR 03 ALARM (N/A), BLR 03 COMM ALARM (N/A), BLR 03 RUNTIME ALARM (N/A), BLR 03 SW TEMP ALARM (N/A), BLR 03 FLOW ALARM (N/A), BLR 03 RECIRC PUMP ALARM (N/A), BLR 03 FG TEMP ALARM (N/A), BLR 03 CP HAND ALARM (N/A), BLR 03 VFD COMM ALARM (N/A), BLR 03 EFF ALARM (N/A), and BLR 03 CYCLE ALARM (N/A).
- BOILER 04 (BLR 04) AND PRIMARY PUMP 04 (PHHWP 04):** A list of alarm codes including BLR 04 ALARM (N/A), BLR 04 COMM ALARM (N/A), BLR 04 RUNTIME ALARM (N/A), BLR 04 SW TEMP ALARM (N/A), BLR 04 FLOW ALARM (N/A), BLR 04 RECIRC PUMP ALARM (N/A), BLR 04 FG TEMP ALARM (N/A), BLR 04 CP HAND ALARM (N/A), BLR 04 VFD COMM ALARM (N/A), BLR 04 EFF ALARM (N/A), and BLR 04 CYCLE ALARM (N/A).
- BOILER 05 (BLR 05) AND PRIMARY PUMP 05 (PHHWP 05):** A list of alarm codes including BLR 05 ALARM (N/A), BLR 05 COMM ALARM (N/A), BLR 05 RUNTIME ALARM (N/A), BLR 05 SW TEMP ALARM (N/A), BLR 05 FLOW ALARM (N/A), BLR 05 RECIRC PUMP ALARM (N/A), BLR 05 FG TEMP ALARM (N/A), BLR 05 CP HAND ALARM (N/A), BLR 05 VFD COMM ALARM (N/A), BLR 05 EFF ALARM (N/A), and BLR 05 CYCLE ALARM (N/A).

(5) Secondary Heating Hot Water Loop

The screenshot displays a web-based interface for the County of Alameda. The top navigation bar includes 'SCHEDULES', 'ALARMS', 'DOCUMENTS', 'LEGEND', and 'SERVICE NUMBER: 1 (800) 960-0922'. The main menu shows 'HOME', 'FLOORPLANS', 'AIR HANDLER UNITS', 'HEATING HOT WATER SYSTEM' (selected), 'DOMESTIC HOT WATER SYSTEM', and 'CHILLED WATER SYSTEM'. The central heading is 'SECONDARY HEATING HOT WATER LOOP SETTINGS AND ALARM' with a sub-heading 'STATUS / ALARM CODES'. The interface is divided into several panels:

- PRIMARY LOOP (HHWL-P) MODE:** A list of parameters with values like NULL, N/A, and checkmarks.
- COMMON SECONDARY LOOP (HHWL-COM) MODE:** A table with parameters like ENABLE CMD, SW TEMP SP, SW FLOW, SW TEMP, SHHWP LEAD, and SHHWP STAGE.
- WILEY MANUEL SECONDARY LOOP (HHWL-WMC) MODE:** A table with parameters like SHHWP 05 FLOW DESIGN, SHHWP 05 ALARM, SHHWP 05 CMD ALARM, SHHWP 05 HAND ALARM, SHHWP 06 FLOW DESIGN, SHHWP 06 ALARM, SHHWP 06 CMD ALARM, and SHHWP 06 HAND ALARM.
- GLENN DYER SECONDARY LOOP (HHWL-GDF) MODE:** A table with parameters like SHHWP 07 FLOW DESIGN, SHHWP 07 ALARM, SHHWP 07 CMD ALARM, SHHWP 07 HAND ALARM, SHHWP 08 FLOW DESIGN, SHHWP 08 ALARM, SHHWP 08 CMD ALARM, and SHHWP 08 HAND ALARM.
- DWH/TW SECONDARY LOOP (HHWL-DHW) MODE:** A table with parameters like SHHWP 09 FLOW DESIGN, SHHWP 09 ALARM, SHHWP 09 CMD ALARM, SHHWP 09 HAND ALARM, SHHWP 10 FLOW DESIGN, SHHWP 10 ALARM, SHHWP 10 CMD ALARM, and SHHWP 10 HAND ALARM.

(6) Air Handling Unit

TBD

E. PERFORMANCE PAGE EXAMPLES:

(7) Primary Heating Hot Water Loop

PRIMARY HEATING HOT WATER LOOP PERFORMANCE

STATUS / ALARM CODES

PRIMARY LOOP (HHWL-P) MODE	
MODE	NULL
ACTIVE SYSTEM	NULL
BOILER LEAD	NULL
MODE SHUTDOWN	N/A
SYSTEM ENABLE	N/A
EFF ALARM OFFSET SPT	N/A
ENERGY	N/A
NG TOTAL (BTUH)	N/A
EFFICIENCY	N/A
EFFICIENCY EXPECT	N/A
EFF ALARM OFFSET	N/A
EFF ALARM DELAY	N/A
BOILERS CMD ENABLE	N/A
BOILERS SETPOINT	N/A
HHWS FM-COM	N/A
HHWR FM-COM	N/A
HHWS FM-EAST	N/A
HHWS FM-WEST	N/A
HHWR FM-EAST	N/A
HHWR FM-WEST	N/A
HWST-COM	N/A
HWRT-COM	N/A
HHWST-EAST	N/A
HHWST-WEST	N/A
HHWRT-EAST	N/A
HHWRT-WEST	N/A
SPS1 DP	N/A
MAGS DP	N/A
HHWR PS BYPASS	N/A

BOILER 01 (BLR 01) AND PRIMARY PUMP 01 (PHHWP 01)	
BLR 01 STATUS	N/A
BLR 01 EXT SPK STS	N/A
BLR 01 FAN POWER STS	N/A
BLR 01 FAN FLOW STS	N/A
BLR 01 DRAIN STS	N/A
BLR 01 MANUAL HL RESET	N/A
BLR 01 FIRE RATE	N/A
BLR 01 VLV STS	N/A
BLR 01 PRES STS	N/A
BLR 01 SW TEMP	N/A
BLR 01 RW TEMP	N/A
BLR 01 SW FLOW	N/A
BLR 01 SW FLOW TOTAL	N/A
BLR 01 NG FLOW	N/A
BLR 01 NG FLOW TOTAL	N/A
BLR 01 FG TEMP	N/A
PHHWP 01 ON/OFF STATUS	N/A
PHHWP 01 VFD SPD	N/A
BLR 01 MAINT TIME	N/A
BLR 01 TIME	N/A

BOILER 02 (BLR 02) AND PRIMARY PUMP 02 (PHHWP 02)	
BLR 02 STATUS	N/A
BLR 02 EXT SPK STS	N/A
BLR 02 FAN POWER STS	N/A
BLR 02 FAN FLOW STS	N/A
BLR 02 DRAIN STS	N/A
BLR 02 MANUAL HL RESET	N/A
BLR 02 FIRE RATE	N/A
BLR 02 VLV STS	N/A
BLR 02 PRES STS	N/A
BLR 02 SW TEMP	N/A
BLR 02 RW TEMP	N/A
BLR 02 SW FLOW	N/A
BLR 02 SW FLOW TOTAL	N/A
BLR 02 NG FLOW	N/A
BLR 02 NG FLOW TOTAL	N/A
BLR 02 FG TEMP	N/A
PHHWP 02 ON/OFF STATUS	N/A
PHHWP 02 VFD SPD	N/A
BLR 02 MAINT TIME	N/A
BLR 02 TIME	N/A

BOILER 03 (BLR 03) AND PRIMARY PUMP 03 (PHHWP 03)	
BLR 03 STATUS	N/A
BLR 03 EXT SPK STS	N/A
BLR 03 FAN POWER STS	N/A
BLR 03 FAN FLOW STS	N/A
BLR 03 DRAIN STS	N/A
BLR 03 MANUAL HL RESET	N/A
BLR 03 FIRE RATE	N/A
BLR 03 VLV STS	N/A
BLR 03 PRES STS	N/A
BLR 03 SW TEMP	N/A
BLR 03 RW TEMP	N/A
BLR 03 SW FLOW	N/A
BLR 03 SW FLOW TOTAL	N/A
BLR 03 NG FLOW	N/A
BLR 03 NG FLOW TOTAL	N/A
BLR 03 FG TEMP	N/A
PHHWP 03 ON/OFF STATUS	N/A
PHHWP 03 VFD SPD	N/A
BLR 03 MAINT TIME	N/A
BLR 03 TIME	N/A

BOILER 04 (BLR 04) AND PRIMARY PUMP 04 (PHHWP 04)	
BLR 04 STATUS	N/A
BLR 04 EXT SPK STS	N/A
BLR 04 FAN POWER STS	N/A
BLR 04 FAN FLOW STS	N/A
BLR 04 DRAIN STS	N/A
BLR 04 MANUAL HL RESET	N/A
BLR 04 FIRE RATE	N/A
BLR 04 VLV STS	N/A
BLR 04 PRES STS	N/A
BLR 04 SW TEMP	N/A
BLR 04 RW TEMP	N/A
BLR 04 SW FLOW	N/A
BLR 04 SW FLOW TOTAL	N/A
BLR 04 NG FLOW	N/A
BLR 04 NG FLOW TOTAL	N/A
BLR 04 FG TEMP	N/A
PHHWP 04 ON/OFF STATUS	N/A

BOILER 05 (BLR 05) AND PRIMARY PUMP 05 (PHHWP 05)	
BLR 05 STATUS	N/A
BLR 05 EXT SPK STS	N/A
BLR 05 FAN POWER STS	N/A
BLR 05 FAN FLOW STS	N/A
BLR 05 DRAIN STS	N/A
BLR 05 MANUAL HL RESET	N/A
BLR 05 FIRE RATE	N/A
BLR 05 VLV STS	N/A
BLR 05 PRES STS	N/A
BLR 05 SW TEMP	N/A
BLR 05 RW TEMP	N/A
BLR 05 SW FLOW	N/A
BLR 05 SW FLOW TOTAL	N/A
BLR 05 NG FLOW	N/A
BLR 05 NG FLOW TOTAL	N/A
BLR 05 FG TEMP	N/A
PHHWP 05 ON/OFF STATUS	N/A

(8) Secondary Heating Hot Water Loop

Oakland, CA NULL NULL 2:44 AM SCHEDULES ALARMS DOCUMENTS LEGEND SERVICE NUMBER: 1 (800) 960-0922

COUNTY OF ALAMEDA HOME FLOORPLANS AIR HANDLER UNITS HEATING HOT WATER SYSTEM DOMESTIC HOT WATER SYSTEM CHILLED WATER SYSTEM

SECONDARY HEATING HOT WATER LOOP PERFORMANCE

STATUS / ALARM CODES

PRIMARY LOOP (HHWL-P) MODE	
MODE	NULL
ACTIVE SYSTEM	NULL
BOILER LEAD	NULL
MODE SHUTDOWN	N/A
SYSTEM ENABLE	N/A
EFF ALARM OFFSET SPT	N/A
ENERGY	N/A
NG TOTAL (BTUH)	N/A
EFFICIENCY	N/A
EFFICIENCY EXPECT	N/A
EFF ALARM OFFSET	N/A
EFF ALARM DELAY	N/A
BOILERS CMD ENABLE	N/A
BOILERS SETPOINT	N/A
HHWS FM-COM	N/A
HHWR FM-COM	N/A
HHWS FM-EAST	N/A
HHWS FM-WEST	N/A
HHWR FM-EAST	N/A
HHWR FM-WEST	N/A
HWST-COM	N/A
HWRT-COM	N/A
HHWST-EAST	N/A
HHWST-WEST	N/A
HHWRT-EAST	N/A
HHWRT-WEST	N/A
SPS1 DP	N/A
MAGS DP	N/A
HHWR PS BYPASS	N/A

COMMON SECONDARY LOOP (HHWL-COM) MODE	
SW FLOW	NULL
SW TEMP	NULL

WILEY MANUEL SECONDARY LOOP (HHWL-WMC) MODE	
RW TEMP	N/A
RW TEMP	N/A
SHHWP 05 ON/OFF CMD	N/A
SHHWP 05 ON/OFF STS	N/A
SHHWP 05 RUNTIME	N/A
SHHWP 06 ON/OFF CMD	N/A
SHHWP 06 ON/OFF STS	N/A
SHHWP 06 RUNTIME	N/A

GLENN DYER SECONDARY LOOP (HHWL-GDF) MODE	
RW TEMP	N/A
RW TEMP	N/A
SHHWP 07 ON/OFF CMD	N/A
SHHWP 07 ON/OFF STS	N/A
SHHWP 07 RUNTIME	N/A
SHHWP 08 ON/OFF CMD	N/A
SHHWP 08 ON/OFF STS	N/A
SHHWP 08 RUNTIME	N/A

DWI/TW SECONDARY LOOP (HHWL-DHW) MODE	
SHHWP 09 ON/OFF CMD	N/A
SHHWP 09 ON/OFF STS	N/A
SHHWP 09 RUNTIME	N/A
SHHWP 10 ON/OFF CMD	N/A
SHHWP 10 ON/OFF STS	N/A
SHHWP 10 RUNTIME	N/A

(9) Air Handling Unit

TBD

VI.E SOLAR THERMAL SYSTEMS



**THE COUNTY OF ALAMEDA SUPPLEMENTAL DESIGN GUIDELINES
FOR
SOLAR THERMAL SYSTEMS**

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THE COUNTY OF ALAMEDA SUPPLEMENTAL DESIGN GUIDELINES FOR SOLAR THERMAL SYSTEMS

1.01 INTRODUCTION

Alameda County General Services Agency (GSA) created Solar Thermal System design guideline to guide design and construction professionals to complete lasting, high-quality additions to the County's built environment. These guidelines, along with applicable codes, ensure that new construction and renovation projects at the County of Alameda integrate industry best practices and experience with existing county buildings, infrastructure, grounds, and maintenance issues.

This guideline is not a specification, however, the performance criteria included herein is required for solar thermal projects, in whole or in part, to supplement a specification or to be included as attachment, or exhibit. Each project will have unique requirements and this guideline may not include all the information required to develop a complete specification; therefore it is not permitted to copy the guideline verbatim in specifications or in notes on drawings unless authorized by GSA. Refer questions and comments regarding the content and use of this documents to the GSA Project Manager or representative.

This guideline is intended to be read in conjunction with the local codes and authorities have jurisdiction of the work, and in no way are to be considered as a code replacement. The codes and regulations represent the minimum acceptable standard. Where the technical design requirements differ from the building codes and other applicable codes and standards, the more stringent of the codes shall be applied.

Due to the nature and advancement of technology, this guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

1.02 RELEVANT DESIGN GUIDELINES

- A. Not all relevant standards and guidelines are included or referenced in this document. Additional guidelines, if available, will be provided as separate guideline as part of a more comprehensive set of guidelines for County projects. It is the responsibility of the design and construction professionals to request all relevant information and standards from the County Project Manager or County representatives.

1.03 REFERENCES and STANDARDS

- A. The design, products, and installation shall comply with at least, but not limited to, the following electrical industry standards, wherever applicable:
 - (1) Institute of Electrical and Electronics Engineers (IEEE) Standards
 - (2) National Electrical Manufacturers Association (NEMA)
 - (3) National Electric Code (NEC)
 - (4) Solar Rating and Certification Corporation (SRCC)
 - (5) Underwriters Laboratories, Inc. (UL)
 - (6) National Fire Protection Association (NFPA)
 - (7) Local Utility Requirements
 - (8) American National Standards Institute (ANSI)
 - (9) Occupational Health and Safety Administration (OSHA)
 - (10) American Society for Testing and Materials (ASTM)
 - (11) National Electrical Contractors Association (NECA)

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- (12) National Electrical Testing Association (NETA)
- (13) International Building Code (IBC)
- (14) California Building Codes (CBC)
- (15) California Building Standards Commission Code (BSC)
- (16) All other Authorities Having Jurisdiction

1.04 REQUIRED SUBMITTALS

- A. Solar Rating & Certification Corporation Standard 100 Minimum Standards for Solar Thermal Collectors (ICC 901/SRCC OG-100)
- B. Solar Rating & Certification Corporation Standard 300 Minimum Standards for Solar Water Heating Systems (ICC 900/SRCC OG-300)
- C. Solar Rating & Certification Corporation Standard 300 Minimum Standards for Solar Pool and Spa Heating Systems (ICC 902/PHTA 902/SRCC OG-400)
- D. If required, FAA Form 7460-1, both submitted and approved forms.
- E. Schematic Design documents consisting of drawings and other documents illustrating the scale and relationship of Project components, including but not limited to, schematic design studies, site utilization plans, solar thermal array layouts and design information, a shading analysis, equipment lists and bills of material, and equipment cut sheets or specifications.
- F. Design Development documents consisting of elevations, cross sections, and other drawings and documents necessary to depict the design of the system(s). This submittal includes architectural, structural, geotechnical, mechanical and electrical design documents and equipment specifications to illustrate the size, character, and quality of the Project and demonstrate that it meets the performance guidelines. The Design Development documents shall represent 100% of the intended scope and system.
- G. Construction Documents (CDs) depicting the detailed construction requirements of the system(s). CDs shall conform to all applicable governmental, regulatory, and code requirements, and all pertinent federal, state, and local permitting agencies. The CDs shall show the work to be done, as well as the materials, workmanship, finishes, and equipment required for the system(s). CDs shall comply with and illustrate methods to achieve the performance guidelines. CDs shall be stamped by the engineer of record and any other required engineering disciplines.
- H. Comprehensive submittal package for each phase of the Work that will be reviewed and approved by the Purchaser-Owner. At a minimum, each submittal package shall include the elements required to convey in sufficient detail the following for each phase of the design:
 - (1) Site Layout Drawings, with distances from roof edges and existing equipment
 - (2) Identification and connection details regarding the new systems points of connections with existing systems (makeup water, hot water, electrical, etc.)
 - (3) Capacity analyses of the existing infrastructure (electrical, piping, drains, etc.) impacted by the project.
 - (4) Descriptions of any necessary modifications, including capacities, to the

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existing infrastructure.

- (5) Installation Details (trenching, mounting, etc.)
- (6) Equipment Layout Drawings
- (7) Detailed Drawings
- (8) Piping and Mechanical Diagrams and Details
- (9) Electrical Single-Line and Three-Line Diagrams
- (10) Electric Wire and Conduit Schedule
- (11) Network Connection Diagrams
- (12) Architectural Drawings
- (13) Structural Drawings including roof penetration.
- (14) Geotechnical Drawings
- (15) Manufacturer's Cut Sheets with Equipment Specifications
- (16) Data Acquisition System (DAS) Specifications, Cut Sheets, and Data Specifications

I. CLOSE-OUT SUBMITTAL REQUIREMENTS

- (1) Close-Out documents prepared by Design-Builder must include at minimum, but not limited to, the following items:
 - a) Final As-Built Drawing Set, provided in two (2) hard copy sets and an electronic copy in DWG format (or as desired by Purchaser-Owner)
 - b) Component warranties
 - c) Signed inspections cards from AHJ and required Special Inspections
 - d) Owner's Manual

1.05 GENERAL CONSIDERATIONS

- A. Approved Manufacturer
 - (1) ergSol, or equivalent.
- B. Non-concentrating and non-tracking systems only and capable of producing temperatures up to 300 °F for the following systems:
 - (1) Laundry
 - (2) Kitchen
 - (3) Space Heating and Cooling
 - (4) Tempered Water Systems
- C. Use of mirrors is not acceptable.
- D. All products and equipment are required to be entered in the County's computerized maintenance management system, Corrigo.
- E. Thermal Storage shall be considered for all solutions.

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1.06 PERFORMANCE MODELING

- A. Performance modeling of the solar thermal system shall be performed using Polysun or equivalent modeling software using weather data for the location closest to the site. The simulations shall accurately utilize proposed system layouts, sizes, and orientation to demonstrate projected production. It is critical that solar thermal performance models accurately encompass proposed system specifications, with all methodology and assumptions described. The Purchaser-Owner will independently verify performance models are accurate to the designed systems and utilize simulations for economic evaluations. Updates to the performance models are required each time sufficient changes are made to the proposed system designs that will impact system performance.

System shall avoid excessive shading on collectors to the extent possible. Where shading losses are encountered, a shading analysis is required justifying the basis for their design, including any proposed tree removal, and explaining why shading does not create an adverse performance and/or economic impact.

- B. The following sets of solar thermal generation data is required:

- (1) 15-Minute Generation Data for the entire year
- (2) Monthly Generation Data, for each month of the year
- (3) Annual Generation Data

- C. Solar thermal generation data file format

- (1) Excel
- (2) CSV

1.07 PERMITS AND APPROVALS

- A. Construction Documents must be reviewed and approved by all authorities having jurisdiction (AHJs) over the work, which may include, but are not limited to, the following.

- (1) Purchaser-Owner
- (2) City or County in which the work is being done.
- (3) Local Utility
- (4) Office of Statewide Health Planning and Development (OSHPD)
- (5) Fire Department in which the work is being performed.
- (6) California Department of Corrections and Rehabilitation (CDCR)

- B. Submitting for and obtaining all approvals for permitting requirements for system designs, pricing, and schedule.

- C. Documentation in sufficient detail is required to obtain all regulatory approvals requested for design, installation and operation of the system, including but not limited to all federal, state, and local permits.

- D. Meetings and verification site visits requested by the AHJ are required.

- E. Installation shall satisfy all incentive, grant, and all other programs including any special inspections for piping, wiring, trenching and roof attachment work.

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F. If required, FAA Form 7460-1

1.08 TECHNICAL REQUIREMENTS

- A. This specification addresses the installation of solar thermal hot water systems for use in domestic hot water heating or in swimming pool heating. All systems must meet the qualifications for obtaining an incentive from any local utility incentive program and any available grant, whether or not incentives are available at the time of construction.
- B. Conform to all local utility requirements including precertification requirements.
- C. Participation in utility incentive program may require energy efficiency audit/survey. All audits conducted as part of this project shall be submitted as part of the approval process and to obtain and meet all regulatory and incentive program requirements.
- D. The Minimum Design Life for solar domestic and heating hot water systems is twenty (20) years.
- E. The Minimum Design Life for solar swimming pool heaters is twelve (12) years.
- F. All documentation and components furnished for a project shall be developed, designed, and/or fabricated using high quality design, materials, and workmanship meeting the requirements of the Purchaser-Owner and all applicable industry codes and standards.
- G. Conformity to all specification, recommendations, and guidelines from equipment manufacturers.

1.09 SOLAR THERMAL COLLECTORS

- A. Provided collectors that meet Solar Rating & Certification Corporation Standard 100 Minimum Standards for Solar Thermal Collectors (SRCC OG-100)
- B. Provided collectors that meet Solar Rating & Certification Corporation Standard 300 Minimum Standards for Solar Water Heating Systems (SRCC OG-300)
- C. All equipment shall be new, undamaged, fully warranted without defect.
- D. All equipment and installation shall qualify for CSI Thermal Incentive
- E. Acceptable mounting methods for panels shall be provided by the manufacturer.
- F. Bolted and similar connections shall be non-corrosive and include locking devices designed to prevent twisting.
- G. If collectors using hazardous materials are to be provided, then the environmental impact of the hazardous material usage must be disclosed, including any special maintenance requirements and proper disposal/recycling of the collectors are the end of their useful life.
- H. Glazed Closed Loop Flat Plate Collector: Provide minimum 65% optical efficiency, rugged high quality construction using impact-resistant, anti-reflective solar glass, copper meander/serpentine absorber tube, selective-surface absorber plate, non-degrading thermal insulation and optional rapid connections kits to interconnect collectors, ports for collector temperature sensors, air vents and electronic differential controls.
- I. The collector shall have no less than 95% transmission, eta conversion factor of no less than 0.75 by gross area.

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1.10 SOLAR COLLECTOR ARRAY

- A. Collector array shall be oriented so that all collectors face the same direction.
- B. Space collectors arranged in multiple rows so that no shading from other collectors is evident between 1000 hours and 1500 hours solar time on December 21. Indicate minimum spacing between rows. Collector array must have a minimum surface orientation factor (SOF) of 0.75.
- C. Connect interconnecting array piping between solar collectors, in a reverse-return configuration with approximately equal pipe length for any possible flow path.
- D. Indicate flow rate through the collector array.
- E. Provide each collector bank isolated by valves, with a pressure relief valve and with the capability of being drained. Locate manually operated air vents at system high points, and pitch array piping a minimum of 0.25 inch per foot so that piping can be drained by gravity.
- F. Provide calibrated balancing valves at the outlet of each collector bank as indicated.
- G. Supports for Solar Collector Array: Utilize the existing support structure and recertify that it will be covered under a warranty of ten (10) years with an optional twenty (20) warranty.
- H. Provide a support structure as required for the collector array of aluminum, stainless steel, or other corrosion-resistant approved material.
- I. Furnish a support structure which secures the collector array at the proper tilt angle with respect to horizontal and orientation with respect to true south.
- J. Provide a support structure that will withstand the static weight of filled collectors and piping, wind, seismic, and other anticipated loads without damage.
- K. Provide a support structure which allows access to all equipment for maintenance, repair, and replacement.
- L. Neoprene or EPDM washers shall separate all dissimilar metals. Depending on system type, supports for solar array could terminate in ballast blocks to avoid roof penetrations.

1.11 TRANSPORT SUBSYSTEM

- A. For system designs requiring a heat exchanger, provide a minimum design pressure rating of 150 psi. Construct heat exchanger of 316 stainless steel, titanium, copper-nickel, or brass.
- B. Provide heat exchanger with a capability of withstanding temperatures of at least 240 °F. Tube-in-tube copper side-arm heat exchangers are acceptable for appropriate system types.
- C. Pumps (for active systems): For active solar system designs requiring a pump, provide electrically driven, single-stage, centrifugal type circulating pumps.
- D. Support pumps on a concrete foundation or mounting intended for the purpose, or by the piping on which installed if appropriate to the size.
- E. Construct the pump shaft of corrosion resistant alloy steel with a mechanical seal. Provide stainless steel impellers and casings of bronze.

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- F. Pump motor start stop shall be controlled by the solar thermal temperature control system that is compatible with open communication protocol and meets any utility or grant incentive program requirements complete with manual override (Hand-Off-Automatic).
- G. Pumps shall be installed with isolation valves so the pump can be serviced without draining the system.
- H. Heat Transfer Fluid Heat transfer fluid shall be compatible with all materials in the system and the freeze conditions encountered at the site.
- I. Anti-freeze, conditioners or corrosion inhibitors added to the heat transfer fluid must be non-toxic and intended for use in potable water systems when used with single wall heat exchangers.

1.12 PIPING SYSTEM

- A. Piping system complete with pipe, pipe fittings, valves, strainers, expansion loops, pipe hangers, inserts, supports, anchors, guides, sleeves, and accessories with this specification and the drawings. Pipe shall be designed to observe limits on flow velocity, pressure drop, and gauge pressure associated with the pipe type and characteristics.
- B. Piping flow rates below five (5) feet per second.
- C. Type K copper tubing, ASTM B-88, no other material allowed.
- D. Brazed or flared union and joints only, soldered joints are not allowed.
- E. All fixtures, fitting, connections, and panels shall meet California Code requirements for Lead Free products and the installation of these products as set forth in California Health and Safety Code, Sections 116875-116880.
- F. Provide outside array piping insulation with a capability of withstanding 250 °F, except that piping insulation within 1.5 feet of collector connections shall be capable of withstanding 400°F. Protect outside piping insulation from water damage and ultraviolet degradation with a suitable outer coating manufactured for this purpose (aluminum, sunlight resistant PVC or approved equal).
- G. Systems with multiple collector banks, provide calibrated balancing valves suitable for 125 psig and 250 °F service. Furnish calibrated balancing valves with bronze body/brass ball construction with seat rings compatible with system fluid and differential readout ports across valve seat area. Provide readout ports fitted with internal insert of compatible material and check valve. Provide calibrated balancing valves with a memory stop feature to allow valve to be closed for service and reopened to set point without disturbing balance position, and with a calibrated nameplate to assure specific valve settings. Provide calibrated balancing valves and ball valves at the outlet of each collector bank. The balancing valves are specified to allow the array to be flow balanced. The ball valves are required to enable the array to be disconnected for maintenance or repair.
- H. Provide pressure gauges with throttling type needle valve or a pulsation dampener and shutoff valve. Furnish a 3-1/2 inch minimum dial size for primary and secondary supply and return piping systems.
- I. Supply thermometers with wells and separable bronze sockets for primary and secondary supply and return piping systems.

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- J. Support and hang piping so that the weight of the piping is not supported by drywall, siding, or other building members not designed to bear load. Support piping so that thermal expansion and contraction of pipe lengths is accommodated. Supports shall be installed to ensure piping does not sag.
- K. Provide valves compatible with the piping. Ball valves shall be used for shutoff, with full port, bronze body, bronze ball and Teflon seat. Bronze hose-end gate valves shall be used for draining low points of piping.
- L. All exposed and accessible hot water piping must be insulated.
- M. Piping shall be designed and installed so that pipe flow velocities shall not exceed 4 feet per second.
- N. Data acquisition equipment shall be integrated into building energy management systems.
- O. All control software sequences, databased, and licenses are required and shall be handed over to the County to restore the system to design condition.

1.13 ELECTRICAL COMPONENTS

- A. Provide electrical equipment and wiring in accordance with NFPA 70, the NEC, and UL. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified. Provide each motor of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be high efficiency ECM motors.

1.14 MOUNTING SYSTEMS

- A. Design and install such that the panels may be fixed with reliable components proven in similar projects, and shall be designed to resist dead load, live load, corrosion, UV degradation, wind loads, and seismic loads appropriate to the geographic area over the expected twenty-five (25) year lifetime.
- B. Provide a design and system that meets the requirements imposed by Federal, State, and local jurisdictions in effect at the time of execution and any pending code decisions affecting the design shall be identified during Schematic Design.
- C. Provide Analysis, including calculations, of each structure affected by the performance of the scope described herein. The analysis shall demonstrate that existing structures are not compromised or adversely impacted by the installation of panels, equipment, or other activity related to the proposed system. Mounting systems must also meet the following requirements at a minimum:
 - (1) All structural components, including array structures, shall be designed in a manner commensurate with attaining a minimum twenty-five (25) year design life. Particular attention shall be given to the prevention of corrosion at the connections between dissimilar metals.
 - (2) Thermal loads caused by fluctuations of component and ambient temperatures shall be accounted for in the design and selection of mounting systems such that neither the mounting system nor the surface on which it is mounted shall degrade or be damaged over time.
 - (3) Each collector mounting system must be certified by the collector manufacturer as (1) an acceptable mounting system that shall not void the

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module warranty, and (2) that it conforms to the module manufacturer's mounting parameters.

- (4) Final coating and paint colors shall be reviewed and approved by the Purchaser-Owner during Design Review.
- (5) Painting or other coatings must not interfere with the grounding and bonding of the array.

1.15 CORROSION CONTROL

- A. Provide stainless steel 316L fasteners and hardware throughout system or material of equivalent corrosion resistance.
- B. Racking components shall be anodized aluminum, hot-dipped galvanized steel, or material of equivalent corrosion resistance.
- C. Unprotected steel not to be used in any components.
- D. Mounting shall utilize historical values, analysis and research to determine the basic wind velocity for that geographic area. Each system and associated components must be designed and selected to withstand the environmental conditions of the site (e.g., temperatures, winds, rain, flooding, etc.) to which they will be exposed.
- E. System selection and designs shall factor in natural frequency of vibrations so that it doesn't coincide with the specific wind speed range.

1.16 ROOFING REQUIREMENTS

- A. The installation of solar modules, inverters and other equipment shall provide adequate room for access and maintenance of existing equipment on the building roofs.
- B. A minimum of four (4) feet of clearance will be provided between solar equipment and existing mechanical equipment and other equipment mounted on the roof.
- C. A minimum of six feet of clearance shall be provided between solar equipment and the edge of the roof.
- D. Where system is installed within six (6) feet of a leading edge and rooftop pathway for walking is within the six feet, fall protection shall be installed according to all applicable codes. Clearance guidelines of the local fire marshal shall be followed.
- E. Where rooftop pathway for walking is within the six (6) feet and fall protection CANNOT be installed according to all applicable codes, solar shall be installed within ten (10) feet of a leading edge.
- F. The installation of solar or thermal systems will be reviewed for code compliance and adherence to the *State Fire Marshal Guidelines*.
- G. The system and system equipment shall not be installed in a way that obstructs air flow into or out of building systems or equipment.
- H. Roof top mounted systems may be ballasted, standing seam attachment, or penetrating systems and must meet or exceed the following requirements:
 - (1) Systems shall not exceed the ability of the existing structure to support the entire solar system and withstand increased wind uplift and seismic loads. The capability of the existing structure to support proposed solar systems shall be verified by the installing contractor prior to construction.

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- (2) Roof penetrations, if part of the mounting solution, shall be kept to a minimum.
- (3) Perform all work so that existing roof warranties shall not be voided, reduced, or otherwise negatively impacted.
- (4) No work shall compromise roof drainage, cause damming or standing water or cause excessive soil build-up.
- (5) All materials and/or sealants must be chemically compatible.
- (6) Thermal movement that causes scuffing to the roof must be mitigated as part of the mounting solution.
- (7) All penetrations shall be waterproofed.
- (8) Detail(s) for the sealing of any roof penetrations shall be approved in writing to the Purchaser-Owner, as well as the manufacturer of the existing roofing system, as part of the project approval – prior to the installing contractor proceeding with work.
- (9) All roofing penetrations and waterproofing shall be performed or overseen by a licensed roofing contractor who is certified by the roofing materials manufacturer for the specific materials or systems comprising each roof upon which a solar system will be installed. The roofing contractor shall also be safety prequalified by the Purchaser-Owner.
- (10) The following certification are required by the project:
 - a) All work performed by a certified installer of Complete Roofing System.
 - b) The manufacturer’s Technical Representative is qualified and authorized to approve project.
 - c) Project Plans and specs meet the requirements of the warranty of the Complete Roofing System for the specified period.
 - d) Existing warranty incorporates the new roofing work and flashing work. All warranties and work related to the solar system shall be certified in writing by roofing manufacturer.
- (11) Any damage to roofing material during installation of solar systems shall be remedied.
- (12) The installation of solar modules and other equipment on building roofs will be installed to minimize visibility of the equipment from the ground.

1.17 ANCILLARY EQUIPMENT ENCLOSURES

- A. Design-Builder will be responsible for incorporating the following elements in the design and construction of the System:
- (1) Fencing: all ancillary equipment be grouped to a single location per site and shall be surrounded by a fence to prevent access by unauthorized personnel. The fence shall be a eight (8) foot high chain link fence with vinyl privacy slats. This requirement may be waived based on a site-by-site basis.
 - (2) Location: all ancillary equipment shall be located in a manner that minimizes its impact to normal operations and minimizes the visual impacts to the site.

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1.18 INFRASTRUCTURE FOR GROUND MOUNT SYSTEMS

- A. The site shall be surrounded by a fence to prevent unauthorized personnel from gaining access the site. The fence shall be an eight (8) foot high chain link fence with vinyl privacy slats.
- B. Gates shall be installed to enable site access for trucks.
- C. A pathway a minimum of ten (10) feet wide passable by a maintenance truck shall be provided within the array fence to allow for access to all equipment enclosed within the fence area.
- D. Water line shall be installed for maintenance (module cleaning) purposes.
- E. Low voltage (120V) AC power to power maintenance equipment and miscellaneous equipment shall be installed.
- F. Security cameras shall be installed on site to monitor array area, connected to the site's security system, in collaboration with the Purchaser-Owner.
- G. Surface cover material shall be installed under and around the modules and throughout the site that provides appropriate weed control, erosion and dust management.
- H. Access road shall be installed to access any ground mount system for maintenance and fire access purposes. The access road shall be passable under all weather conditions.
- I. All underground pull boxes shall be:
 - (1) Non-metallic material
 - (2) Minimum raceway size shall be 8 times the diameter of the largest conduit
 - (3) Concrete or other non-metallic material animal proof bottom with drainage, the pull box shall be complete to eliminate animals burrowing into the box.
 - (4) Shall include one spare conduit for future at the same size of the maximum installed conduit.
- J. Conduit:
 - (1) Non-metallic material, include trace wire.
 - (2) One spare conduit shall always be installed.

1.19 LIGHTNING AND SURGE PROTECTION

- A. Lightning arrestors to protect appropriate equipment from lightning strikes.
- B. Surge suppressors to protect the appropriate equipment from electrical surges.

1.20 LABELING

- A. Labeling shall meet requirements and content of ICC 900/SRCC 300 Solar Thermal System Standards, including but not limited to:
 - (1) Storage Tank Volume
 - (2) Expansion Tank Volume
 - (3) Relief Valve Specification and Setpoint
 - (4) Maximum and operating loop pressures and temperatures
 - (5) Flow Rate and Direction

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- (6) Installation Date
- (7) System Manufacturer's name and number, for each system
- (8) Piping labels to clearly indicate solar thermal.
- (9) Electrical requirements (phase, voltage, and maximum current, etc.).
- (10) Weatherproof sign or placard of system layout indicating array layout and flow path.

1.21 MONITORING SYSTEM, DAS, AND REPORTING

- A. Monitoring System, DAS, and Reporting for a specific system size shall meet the requirements of the local utility programs and or grant requirements.
- B. All systems shall include a monitoring system and be integrated into the building automation system. At a minimum, but not limited to, the following data:
 - (1) Solar Thermal Supply and Return Temperatures
 - a) Depending on the size, this may include multiple locations within the system or array.
 - (2) System Pressure, supply and return headers.
 - (3) Irradiance
 - (4) Surface Temperatures
 - (5) Storage Tank Temperatures, Pressure, level
 - (6) Pump operational points.
 - (7) Supply and Return system information to the building.
 - (8) Blending Valve Operational Information
- C. Data Acquisition Systems (DAS) that enable the Purchaser-Owner to track the performance of the Solar Systems as well as environmental.
- D. Manual in printed or on-line form that describes how to use the monitoring system, including the export of data and the creation of custom reports.

1.22 FAA REQUIREMENTS

- A. Responsible for submitting the appropriate FAA Form 7460-1, along with any other required forms and documentation, for all proposed solar systems within the approach or takeoff paths or on the property of airports as defined by the Code of Federal Regulations Title 14 Part 77.9.

1.23 FREEZE PROTECTION

- A. Freeze protection requirements set forth by SRCC and IAMPO for the appropriate climate zone of the site.
- B. Direct forced circulation systems, where potable water is pumped and heated directly in the collector, are not eligible for CSI Thermal rebates, so are not allowed on this contract.

1.24 STAGNATION/OVERHEAT PROTECTION FOR COLLECTORS

- A. Stagnation protection that meets the requirements of utility and grant programs.

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1.25 SHADING

- A. System shall adhere to the following requirements in order to avoid excessive shading on panels. For any object near an array that is higher than the lowest point of that array by height H, Design-Builder shall locate the array farther from the object than:
 - (1) 2H to the North of the object
 - (2) 2H to the East or West of the object
 - (3) 2H to any non-cardinal direction of the object
- B. Where the system design does not adhere to these rules the contractor shall perform a shading analysis justifying the basis for their design, including any proposed tree removal and explaining why shading does not create an adverse performance and/or economic impact.
- C. Tree remediation.
 - (1) Any trees that are in the footprint of systems shall be removed as part of the project costs, subject to the approval of the Purchaser-Owner.
 - (2) A tree shall be considered in the footprint of a system if its canopy would extend over any part of the system, including structural components or modules.
 - (3) The Purchaser-Owner will remove or prune, at its discretion, trees planted outside of the work area that shade solar systems (at present time or in the foreseeable future), provided these trees are identified during the design process.
 - (4) The Design-Builder shall be responsible for any required tree remediation efforts resulting from tree removal that is deemed the Design-Builder's responsibility.

1.26 WARRANTIES

- A. Design-Builder shall provide for the following warranties:
- B. All solar collectors must have a minimum of a ten (10) year manufacturer's performance warranty to protect against defects and a 15% performance degradation.
- C. All systems must have a minimum ten (10) year performance warranty to protect the host against more than a 15% degradation of system performance over the ten (10) year period that may occur due to faulty installation.
- D. All systems must have a minimum one (1) year warranty on installation labor and workmanship not otherwise covered by the manufacturer's performance warranty.
- E. Additional warranty terms that exceed the minimum may be offered.
- F. Twenty (20) year mounting system warranty covering structural integrity and corrosion.
- G. Ten (10) year comprehensive warranty on all system components against defects in materials and workmanship under normal application, installation, and use and service conditions.
- H. All work performed must not render void, violate, or otherwise jeopardize any preexisting Purchaser-Owner facility or building warranties or the warranties of system components.

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1.27 TESTING AND COMMISSIONING

- A. Following services related to startup and performance testing of the systems are required:
- (1) Acceptance Testing
 - (2) System Startup
 - (3) Proving Period
- B. Submit a detailed Testing Plan covering each of the phases for review and approved by the Purchaser-Owner prior to substantial completion of construction. A detailed description of each phase is provided below.
- (1) Acceptance Testing
 - a) Acceptance test for each System. The acceptance test procedures include component tests as well as other standard tests, inspections, safety, and quality checks. All testing and commissioning shall be conducted in accordance with the manufacturer's requirements, specifications, and recommendations.
 - b) Testing Plan that covers Acceptance Testing shall be submitted to the owner prior to the start of construction and should include, but is not limited to, the following:
 - 1) Detailed test methods, including sample calculations and reference to standards as required or applicable, and list of tested equipment.
 - 2) Pre-test checklist to ensure readiness and any safety measures are in-place.
 - 3) Detailed list of all items to be inspected and tests to be conducted.
 - 4) Acceptance Criteria: For each test phase, specifically indicate what is considered an acceptable test result.
 - 5) Testing performance of the collectors relative to insolation, ambient temperature and inlet/outlet temperatures
 - 6) Testing of all sensors of the DAS to confirm accuracy.
 - 7) Temperature sensor diagnostics
 - 8) Testing of the Data Presentation interface of the DAS
 - 9) Piping hydraulic pressure test
 - 10) Water portability test
 - c) After Design-Builder conducts all Acceptance Testing based on the Testing Plan approved by the Purchaser-Owner prior to substantial completion, Design-Builder shall submit a detailed Acceptance Test Report to the Purchaser-Owner for review and approval.
 - d) The Acceptance Test Report shall document the results of the tests conducted following the Testing Plan, and may include, but is not

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limited to the following:

- 1) Date and time of each test
 - 2) Problem and deficiencies found during testing.
 - 3) Troubleshooting completed.
 - 4) Troubleshooting methods and strategy
 - 5) Labor and equipment necessary to troubleshoot the System.
- (2) System Startup
- a) Acceptance test conduct to cover a one-week period (7 days) at a time resolution of fifteen (15) minutes, recording the following data:
 - 1) Thermal output (Btu)
 - 2) In-plane irradiance
 - 3) Ambient temperature
 - 4) Collector inlet temperature
 - 5) Thermal energy storage temperatures
 - 6) Inlet/Outlet water temperatures
 - 7) Pressure
 - b) Data Format:
 - 1) Excel
 - 2) CSV
 - c) Report: data to be presented in a manner that best depicts the actual performance of the system for Purchaser-Owner review and approval and shall be submitted as part of the Startup Test Report. All raw data, means and methods to handed over to the County.
- (3) Proving Period (30 DAYS)
- a) Upon completion of Acceptance Testing and System Startup, and approval by the Purchaser-Owner, Monitor the system during a thirty (30) day Proving Period and submit a report for Purchaser-Owner review and approval prior to final acceptance by the Purchaser-Owner. This includes monitoring system output and ensuring the correct functioning of system components over this time. The values for the following data shall be acquired every fifteen (15) minutes over thirty (30) days:
 - 1) Date and Time of data points
 - 2) Thermal output (Btu)
 - 3) Total Btu's delivered (per tank if system has multiple tanks)
 - 4) In-plane irradiance
 - 5) Ambient temperature
 - 6) Collector inlet temperature

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- 7) Thermal energy storage temperatures
- 8) System availability
- b) Data Format:
 - 1) Excel
 - 2) CSV
- c) Calibrated test instruments and DAS and monitoring system may be used to collect the test data described above, which shall be made available to the Purchaser-Owner for access throughout the Proving Period.
- d) Verify through analysis of data from the Proving Period whether the solar thermal system delivers the expected production as determined by the final approved design (i.e., Construction Documents). Actual production shall be compared against expected production using actual weather data and other system inputs for calculating expected production.
- e) All data and reports required in system testing shall be fully functional and available to the Purchaser- Owner at the commencement of the Proving Period.
- f) Data and reporting requirements are included in the testing scope of the Proving Period and deficiencies in these areas (including missing data, inaccurate reports, and other issues that make validation of system performance inconclusive) shall be grounds for denying approval of the Proving Period Report.
- g) If the solar thermal system does not perform to design specifications, the following is required:
 - 1) Diagnostic testing
 - 2) Deficiencies shall be identified with proposed corrective actions submitted for review.
 - 3) Proving Period test repeated.
- h) The Proving Period Report shall be submitted after the successful completion of this phase and submitted to the for review and approval. The report shall contain, but not be limited to, the following information and calculations. Calculation shall be provided in Excel format with formulas visible to allow for peer review.
 - 1) System description
 - 2) Test period
 - 3) Test results
 - 4) Anomalies identified during test.
 - 5) Corrective action performed.
 - 6) Actual measured performance
 - 7) Calculations detailing expected performance under TMY

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conditions.

1.28 END OF DOCUMENT

VI.F INTERIOR LIGHTING GUIDELINE



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1.01 INTRODUCTION

Alameda County General Services Agency (GSA) created an interior lighting design guideline to guide design and construction professionals to complete lasting, high-quality additions to the County’s built environment. This guideline, along with applicable codes, help ensure that the project specific specifications developed for new construction and renovation projects at the County of Alameda integrate industry best practices and experience with existing county buildings, infrastructure, and maintenance issues.

This guideline is not a specification, however, the performance criteria included herein is required for interior lighting projects, in whole or in part, in a specification or included as attachment, or exhibit. Each project will have unique requirements and this guideline may not include all the information required to develop a complete specification; therefor it is not permitted to copy the guideline verbatim in specifications or in notes on drawings unless authorized by GSA. Refer questions and comments regarding the content and use of these documents to the GSA Project Manager or representative.

Where this guideline conflicts with applicable codes, the codes supersede these requirements. Refer questions and comments regarding the content and use of these documents to the Alameda County Project Manager or representative.

Due to the nature and advancement of technology, this guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

1.02 RELEVANT DESIGN GUIDELINES

- A. Not all relevant standards and guidelines are included or referenced in this document. Additional guidelines, if available, will be provided as separate guideline as part of a more comprehensive set of guidelines for County projects. It is the responsibility of the design and construction professionals to request all relevant information and standards from the County Project Manager or County representatives.

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1.03 REFERENCES and STANDARDS

- A. Lighting systems shall be installed in accordance with these guidelines and the most current, but not limited to, the following standards and Codes:
 - (1) National Electrical Contractors Association (NECA)
 - (2) All State and Local Codes (CCR, CBC, CEC, CGBS, CHBC, ect.)
 - (3) Design Lights Consortium (DLC)
 - (4) Occupational Safety and Health Administration (OSHA)
 - (5) ASHRAE Standard 135
 - (6) National Fire Protection Association (NFPA)
 - (7) Underwriters Laboratories (UL)
 - (8) National Electrical Manufacturers Association (NEMA)
 - (9) American National Standards Institute (ANSI)
 - (10) Illuminating Engineering Society of North America (IESNA)
 - (11) All other Authorities Having Jurisdiction

1.04 REQUIRED SUBMITTALS

- A. New Construction Only: Provide point by point photometric analysis calculations to document proposed lighting system performance to meet performance criteria. Point by point analysis to be provided for each area to be upgraded to LED. Simulations must be performed using approved industry standard software (e.g., DIALux, AGI 32)
 - (1) Specify the software name and version utilized for point-by-point luminance level calculations. Submit electronic files with hard copy report for County review.
 - (2) Provide documentation comparing the results from the model and the field verification measurements along with any necessary updates to the model resulting from the difference between the two (Section 1.08).
- B. Measurement and Verification Reports for existing and installed fixtures and emergency battery backup fixtures.
- C. Provide IES photometry files for all new fixtures.
- D. Provide fixture specification sheets for all products and materials to include fixture photometric performance, iso-footcandle curves, lighting output data, and beam spread.
- E. Provide most recent version of IES LM 79 test reports. This is a test of the fixture light output, energy use, and color spectrum.
- F. Provide most recent version IES LM 80 test reports. This is a test of the LED light source fixture components for depreciation over time.
- G. Provide most recent IES TM 21 test reports. This is a test of fixture performance over time.
- H. Product data for all devices, including efficiency, installation, and programming instructions.
- I. Certificates of Code Compliance

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- J. Lighting Fixture Schedule
- K. Wiring Schematic and Connection Diagram
- L. Lighting control system layout, wiring plan, and one-line diagram.
- M. Occupancy and vacancy sensor coverage layout.
- N. Sequence of operation descriptions for each typical room type, including final programming, schedules, and calibration settings.
- O. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on modifying the lighting control system.
- P. Training materials and manuals shall include calibration, adjustment, troubleshooting, maintenance, repair, and replacement process and procedures.

1.05 GENERAL CONSIDERATIONS

- A. Supplemental Guidelines for Interior Area Lighting. The terms “lighting fixture,” “fixture,” and “luminaire” are used interchangeably.
- B. All proposed fixtures shall be Light-emitting diode (LED) technology unless unique applications, approved by the owner prior to purchasing, require an alternative technology.
- C. This guideline applies to a complete lighting fixture and the individual components (LED lamps, drivers, etc.) that make up a fixture.
- D. At least two locations (private office, conference room, etc.) will be retrofitted with the proposed fixtures to confirm lighting levels meet IES recommendation for the specific space type prior proceeding with installing all the fixtures. Coordinate space types and location to install new fixture or retrofits with owner.
- E. Retrofit and reuse of existing fixtures is preferred after evaluating the condition of the existing fixtures and performance opportunities particularly regarding lighting controls are suitable for reuse. Where new fixtures are required, complete luminaires, including the LED drivers and light sources shall be provided.
- F. All products and equipment that are selected shall be consistent with GSA’s inventory management practices. GSA’s practice is to minimize receiving, tracking, auditing, and managing equipment and items in its storage warehouse inventory by specifying and installing similar equipment in its facilities (e.g., same lamp, fixture, etc.). County operations and maintenance functions and efficiencies are improved by standardizing on one technology to be installed at multiple facilities. Proposed fixtures, lamps, and all other ancillary equipment shall be consistent in each facility and preapproved by the County.
- G. Where lighting also functions to facilitate the work of multiple disciplines, the lighting design will satisfy the operational requirements of each discipline in addition to the general lighting requirements.
- H. All products and equipment are required to be entered in the County’s computerized maintenance management system, Corrigo.
- I. LED technology generally produces a higher quality of light and a more efficient distribution of lumens when compared to legacy technologies. With that in consideration, when legacy systems are retrofit with LED systems, ensure that the projects are designed to maintain close to the minimum maintained-illumination levels

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required for task(s) performed in the area being retrofit. This practice will maximize energy savings and minimize negative glare impacts.

- J. For retrofit and renovation projects, fixtures will typically use existing mounting points. This limitation on re-location of fixtures may inhibit the system performance locations where baseline illumination is already underperforming. In these cases, reasonable effort should be made to design the new system to improve upon the existing system illumination.
- K. In locations where design illumination levels cannot reasonably meet recommended IES levels for existing operations, new fixture mounting points, by relocating or installing new luminaires, may be required. This may include modification to ceilings (gypsum, timber, Polyvinyl Chloride (PVC), acoustic, etc.) or other mounting structures, including modification to a suspended ceiling or hardpan/fixed ceiling systems. The County reserves the right to waive minimum illumination requirements on a location-by-location basis, with the exception for detention facilities.
 - (1) Illumination levels shall be confirmed via baseline energy audit to identify if average illumination levels are too low or high. Results of the audit shall be used to move, repair, and or replace the fixtures as needed or required.
- L. All proposed product families (fixtures and lamps) shall have a proven track record of 10 years unless unique application(s), approved by the owner prior to purchasing, preclude this requirement.
- M. All lighting shall meet illumination levels according to IES recommendations for each space type.
- N. New and retrofit designs must consider important factors such as size & space, occupant preference, ceiling heights and shape, color of walls & furniture, existing lights and electrical setups, traffic patterns, shadows and reflections, daylight integrations, lighting controls, economics and energy efficiency, level of illuminations (lux), etc.

1.06 PERFORMANCE CONSIDERATIONS

- A. This guideline applies to a complete lighting fixture and to the individual components (LED lamps, drivers, etc.) of a fixture.
- B. General Performance Information:
 - (1) Proposed LED fixtures and lamps shall be listed as a qualified product with Design List Consortium (DLC) or IES, otherwise approved by the owner.
 - (2) Where required by the environment or operation, fixture require International Protection or Ingress Protection Rating IP66 rated LED modules or better.
 - (3) Retrofit and new fixtures shall have a Coloring Rendering Index (CRI) of 80 or higher. Exceptions include lamps or fixtures specifically designed to provide colored lighting for effect, site lighting, or other special use.
 - (4) Fixture shall have no fan or otherwise active cooling.
 - (5) Weight and shape of proposed fixtures (total quantity installed per mounting location to meet design criteria) shall be equivalent or reduced from those being replaced (total quantity removed per mounting location) such that static structural and wind loads are maintained or reduced. If this is not the case, installer shall provide structural design analysis showing the proposed

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configuration is sound.

- (6) Luminaires, complete system with LED drivers and light sources, shall meet the design standards herein.
- (7) Fixture retrofits shall maintain UL rating. Owner reserves the right to request certification of UL rating.
- (8) Fixtures with a total harmonic distortion (THD) less than 20%.
- (9) Total new or retrofit low- and high-bay fixtures efficacy > 110 lm/W. Best efficacy should be considered in all applications.
- (10) UL Type A LEDs not permitted, unless approved by GSA.
- (11) Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.
- (12) LED lamps and drivers shall be rated for minimum of 70,000-hour life (L70, i.e., fixture output is reduced to 70% of its initial lumen output).
- (13) Color temperature: 5000K, except lamps or fixtures specifically design to provide colored lighting for effect, site lighting, or other special use.
- (14) Color Rendering Index (CRI) > 80.

1.07 FIXTURE LABELING

- (1) All fixtures shall contain labeling indicating line-voltage (e.g., 277V) of fixture including the maximum re-lamping wattage of the luminaire, including the ballast, if any
- (2) Peel-off or Peel-down label are prohibited.
- (3) Provide labeling templates for review and approval.

1.08 SPACE LIGHTING CONSIDERATIONS

- A. The most common space types and applications at the County are listed below, but this is not a complete list. All applications shall meet the illumination levels according to IES recommendations, which should be referenced for applications not listed below.
- B. Office Lighting
 - (1) Recommended light levels according to the IES (e.g., horizontal average 40 fc at working space for reading, writing, and computer work)
 - (2) LED linear indirect/direct pendants, recessed troffers, wall sconces
 - (3) Color Temperature: 5000K.
 - (4) Greater than 80 CRI.
 - (5) Daylight according to CA Code Title 24.
 - (6) Dimmable down to a minimum of 10%.
 - (7) Illumination Ratio According to the IES, less than 15:1.
 - (8) Vacancy or occupancy control shall be integrated with air terminal unit and zone control. For example, a zone variable air volume box would be controlled to unoccupied setting when the office space or zone is unoccupied.
 - (9) PF greater than 0.9 at full input power and across the dimmable range.

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- C. Conference/Meeting Rooms
 - (1) Recommended light levels according to the IES (e.g., horizontal average of 30 fc at working space for reading, writing, and computer work).
 - (2) LED linear indirect/direct pendants, recessed troffers, wall sconces.
 - (3) Color Temperature: 5000K.
 - (4) Dimmable drivers dimmable down to a minimum of 10%, except where audio/video required drivers are to be dimmable down to 1%
 - (5) Greater than 80 CRI.
 - (6) Daylight according to California Code of Regulations, Title 24.
 - (7) Illumination Ratio According to the IES, less than 15:1.
 - (8) Vacancy or occupancy control, integrated with air terminal unit control.
 - (9) PF greater than 0.9 at full input power and across the dimmable range.

- D. Emergency Lighting
 - (1) General performance:
 - (a) Required designated means of egress routes.
 - (b) Designated routes under emergency lighting need to have an average illumination of 1.0 footcandle (fc) and a minimum of 0.1 fc.
 - (c) Maximum-to-minimum illumination level ratio must be 40:1 or less.
 - (d) Illumination levels are allowed to decline to an average of 0.6 fc, with a 0.06-fc minimum, at the end of a continuous 90-minute discharge period.
 - (e) Shall be powered by emergency circuit, where an emergency generator is installed.
 - (f) Includes an integral self-testing switch.
 - (2) Motion sensor or control from any system is not permitted.
 - (3) Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.
 - (a) Enclosure shall be suitable for the environmental conditions in which installed.
 - (b) Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
 - (c) Battery: Maintenance a minimum of 10 years useful life.
 - (d) Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 90-minute continuous discharge.
 - (e) Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

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- E. Exit Lighting
 - (1) General Requirements:
 - a. LED.
 - b. Luminance of approximately 50 lux or approximately 5 fc.
 - c. Contain two LED Lamps.
 - d. Strong contrast between letters in the sign and sign background.
 - e. Visible and marked by sign reading "EXIT".
 - f. Contain direction arrows indicating the route.
 - g. Comply with UL 924 for signs, visibility, luminance, and lettering size.
 - h. 90-minute backup power for emergency operation.
 - (2) No photo luminance signs are permitted.
 - (3) Complete Fixtures:
 - a) Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous LED mounted in center of letters on red color stable plastic or fiberglass.
 - b) Double-Faced Fixtures: Provide double-faced fixtures where required.
 - c) Directional Arrows: Provide directional arrows as part of the inscription panel. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
 - d) Multi-voltage 120 – 277V.

1.09 FIELD VERIFICATION OF LIGHTING SYSTEM PERFORMANCE

- A. This section provides the framework for a standard measurement and verification (M&V) plan for lighting projects.
- B. Test emergency fixtures according to NFPA and provide documentation that all requirements have been met.
- C. Illuminance of all exit signs shall be measured.
- D. Energy Use Calculations
 - (1) Operating hours are identified during the initial energy survey and are assumed to be the same before and after the equipment retrofit for the purpose of energy use calculations.
 - (2) If controls have been added or modified as part of the installation, the associated energy savings should be separately calculated. In this case, trends need be used for energy use calculations.
 - (3) For new controls that are not time-based (e.g., occupancy sensors and dimming controls), circuit energy use needs to be measured for representative periods (minimum of 2 weeks) to capture representative energy use.

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- (4) Interactive effects on heating and cooling systems from the lighting baseline and post-installation equipment are not considered for interior or exterior installations.
- (5) All installations and real-world conditions are unique; however, equivalent conditions are needed for a reasonable comparison to confirm results.

E. Illuminance Meter

- (1) Purpose: To establish functional light levels for baseline and newly installed lighting technology.
- (2) Accuracy:
 - a) Use a meter with the highest overall accuracy possible.
 - b) Set the measurement meter to the lowest available and applicable measurement range.
 - c) When possible, use the same calibrated measurement meter, otherwise, use the same make and model of calibrated meter across all measurements (pre and post) and between all sites.
 - d) Avoid taking measurements during periods of extreme temperature.
 - e) Recommended practices for meter calibration
 - New meters should be purchased with National Institute of Standards and Technology (NIST) certification
 - Calibrate meters every two years, or according to manufacturer recommendation
 - If multiple meters are available, most recently calibrated units should be used to check accuracy of others.
- (3) Brand Examples:
 - a) Konica Minolta
 - b) Chroma
 - c) Photo Research
 - d) Cooke
 - e) Extech
 - f) Amprobe
 - g) Solar Light
- (4) Documentation:
 - a) Include specifications of measurement equipment used with the testing documentation.
 - b) Most recent calibration documentation

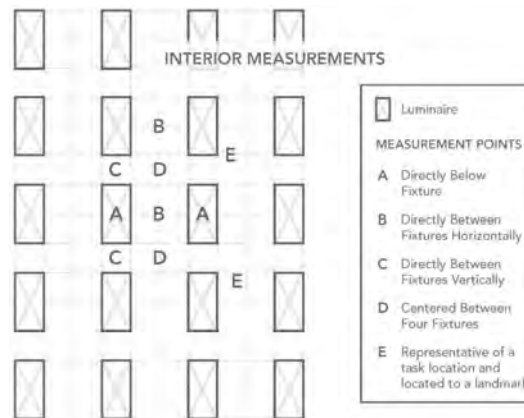
F. Interior Lighting Measurement Grid

- (1) Submit measurement procedures for review and approval by owner.
- (2) Including dimensions from surrounding mounting locations or other structures

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such as walls, columns, etc.

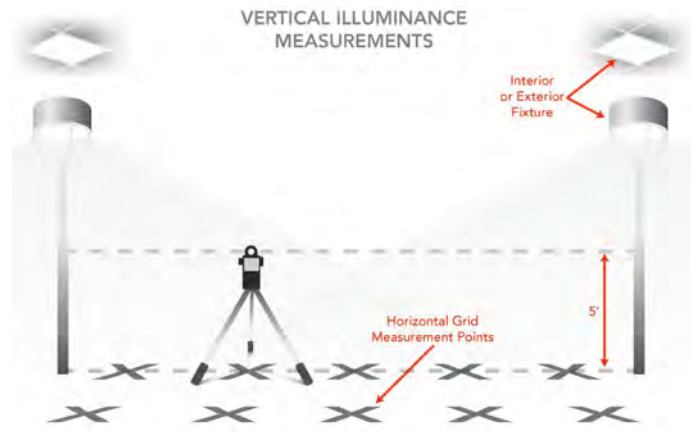
- (3) Identify the measurement locations by marking and/or mapping. It is important to measure the same locations for the baseline and post-installation lighting systems, or the same representative type of locations if fixtures are relocated for the retrofit. Therefore, it is necessary to provide some permanent record of measurement point locations.
- (4) For interior areas, mapping (e.g., using a sketch or marked-up plans/as-builts with dimensions) using non-permanent markers such as cones to delineate reference points and augment permanent site features as permanent reference points are not be allowed or will not be retained between measurements. Make sure to reference the measurement points to some permanent features of the space because desks and other furniture may be moved between the baseline and post-installation measurements.
- (5) Identify a set of measurement points that sufficiently represents the overall lighting of the space for both baseline and post-installation conditions. A representative space will include one office and one conference room and measure the high and low readings on a sample of work surfaces. See sample measurement grid below.



- (6) For each different set of lighting conditions (i.e., different space types or lighting layouts), locate at least 12 measurement points at easily identifiable points. It is commonly very difficult to identify a rigid grid of measurements because of the many variations in layout and obstructions at desk height (work plane) in office environments. Therefore, select a sampling of measurement points both below and between fixtures, in both 90-degree directions and diagonally. Include at least two measurements of each location type and in the most uniform grid pattern possible.
- (7) For circulation-type spaces such as corridors and gathering spaces, establish a measurement grid on the task surface (floor) that includes representative points both directly beneath and between fixtures.
- (8) For office and other task areas, identify a set of measurements points on desktops and other work surfaces that best represents lighting conditions in the space. It may not be possible to develop a uniform spacing grid, but points should be chosen that represent the various lighting conditions across the space.

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- (9) For each separate horizontal grid, identify a vertical plane representative of the lighting in the area (typically the gridline directly between two light fixtures). On this vertical plane, set a grid (line) of points at 5 feet above the site surface at each of the corresponding horizontal measurement points. See example to measure points between task areas below.



G. Measure and Record Illuminance

- (1) Meter “View” Considerations
- a) Ensure the meter measures only the light being emitted by the technologies being tested
 - b) Conduct measurements during periods when potential obstructions can be avoided such as site occupants, cars, or equipment.
 - c) Ensure no objects are obstructing any light to the meter head.
 - d) If a measurement location is partially or fully blocked by a permanent obstruction, eliminate this measurement.
- (2) Testing shall be reproducible and observed by owner for at least one testing location.
- (3) Schedule and take all measurements to minimize the effects of other light sources and location conditions on the results.
- (4) Schedule measurements for both baseline and post-installation when there is no daylight in the space. This typically requires taking measurements after sunset. Adjacent electric lighting need not be blocked or turned off as long as it is noted and remains the same for both the baseline and the post-installation measurements.
- (5) Ensure that potential temporary obstructions such as occupants, temporary materials, and furniture are removed for both the baseline and the post-installation measurements.

H. Additional Documentation

- (1) Provide emergency battery pack measurements, illuminance, and battery runtime.
- (2) Provide illuminance measurements of all exit signs

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- (3) Provide battery test results.
- (4) Provide a permanent record of the selected measure point locations and measurements.
- (5) Take pictures of site conditions, meter setup, and measurement point layout.
- (6) Record the time and ambient temperature at the start and finish of taking measurements.
- (7) Calculate and provide average luminance for each point location for each the baseline, proposed, and post-installation cases in the area specified.
- (8) Project documentation should include as-builts and specifications for the technologies (lighting drivers/ballasts and lamps, batteries, etc.) installed.

1.10 LIGHTING CONTROLS

A. Lighting Controls Systems and Equipment:

- (1) General Considerations:
 - (a) All interior lighting shall be controlled by occupancy sensors and integrated into the building energy management HVAC control system for monitoring and control. Where a building does not have a building energy management control system, interior lighting shall be controlled by local occupancy sensors.
 - (b) All sensors shall be control light levels at IES recommended levels. Lights shall balance daylight and dim where contributing daylight is present.
 - (c) Where daylighting control is installed, automatically balance available daylight using dimmable lighting to maintain lighting levels where the task is being performed at IES recommended levels.
 - (d) Occupancy sensors shall be positioned above work surfaces so that the entire area is covered by the sensor(s) installed.
 - (e) Where hard wiring the interior lighting is not feasible, native BACnet wireless devices operating on 900MHz may be used.
- (2) Private Rooms
 - (a) Daylight harvesting controls for all perimeter offices shall dim to minimum 10% before switching off fixture(s) when adequate daylight is detected by photocell.
 - (b) Hardwired I/O module interfaced with BAS controls.
- (3) Open Rooms
 - (a) Occupancy sensor control in all open office areas. Configure open office with auto on/off. Provide dimming as required by Code.
 - (b) Daylight harvesting controls required for all fixtures adjacent to exterior windows or skylights. Dim to minimum 10% before switching Switch off fixtures when adequate daylight is detected by photocell.
 - (c) Hardwired I/O module interfaced with BAS controls.
- (4) Conference Rooms

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- (a) Multi-zone controls for all conference rooms.
 - (b) Light fixtures closest to projection screens or monitors shall be on a separate lighting zone form the rest of the room.
 - (c) Occupancy sensor controls configured with manual on and auto off and dimming controls. Provide dimming to minimum 1%
 - (d) Hardwired I/O module interfaced with BAS controls.
- (5) Libraries
- (e) Multi-zone controls.
 - (f) Light fixtures closest to projection screens or monitors shall be on a separate lighting zone form the rest of the room.
 - (g) Occupancy sensor controls configured with manual on and auto off and dimming controls. Provide dimming to minimum 1%
 - (h) Hardwired I/O module interfaced with BAS controls.
- (6) Restrooms
- (a) Occupancy sensor controls configured with manual on and auto off and dimming controls.
 - (b) Hardwired I/O module interfaced with BAS controls.
- (7) Lobbies and Corridors
- (a) Occupancy sensors configured for automatic on/off.
 - (b) Daylight harvesting dimming to minimum 10% before turning off fixtures where possible. Coordinate occupancy time delay with the County.
 - (c) Egress lighting may be controlled under certain conditions. Coordinate with the County.
 - (d) Hardwired I/O module interfaced with BAS controls.

1.11 END OF DOCUMENT

VI.G EXTERIOR LIGHTING GUIDELINE



EXTERIOR LIGHTING

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1.01 INTRODUCTION

The County of Alameda General Services Agency (GSA) created exterior lighting design guideline to guide design and construction professionals to complete lasting, high-quality additions to the County's built environment. This guideline, along with applicable codes, ensure that new construction and renovation projects at the County of Alameda integrate industry best practices and experience with existing county buildings, infrastructure, grounds, and maintenance issues.

This guideline is not a specification, however, the performance criteria included herein is required for exterior lighting projects, in whole or in part, to supplement a specification or to be included as attachment, or exhibit. Each project will have unique requirements and this guideline may not include all the information required to develop a complete specification; therefore it is not permitted to copy the guideline verbatim in specifications or in notes on drawings unless authorized by GSA. Refer questions and comments regarding the content and use of this documents to the GSA Project Manager or representative.

This guideline is intended to be read in conjunction with the local codes and authorities have jurisdiction of the work, and in no way are to be considered as a code replacement. The codes and regulations represent the minimum acceptable standard. Where the technical design requirements differ from the building codes and other applicable codes and standards, the more stringent of the codes shall be applied.

Due to the nature and advancement of technology, this guideline may be revised periodically. The most recent revision should be used for the construction, renovation, and retrofit projects.

1.02 RELEVANT DESIGN GUIDELINES

- A. Not all relevant standards and guidelines are included or referenced in this document. Additional guidelines, if available, will be provided as separate guideline as part of a more comprehensive set of guidelines for County projects. It is the responsibility of the design and construction professionals to request all relevant information and standards from the County Project Manager or County representatives.

1.03 REFERENCES and STANDARDS

- A. The design, products, and installation shall comply with at least, but not limited to, the following electrical industry standards, wherever applicable:
 - (1) National Electrical Contractors Association (NECA)
 - (2) California Code of Regulations
 - (3) California Building Codes (CBC)
 - (4) Design Lights Consortium (DLC)
 - (5) Occupational Safety and Health Administration (OSHA)
 - (6) California Energy Codes
 - (7) California Green Building Standards
 - (8) California Historical Building Codes
 - (9) ASHRAE Standard 135
 - (10) National Fire Protection Association (NFPA)
 - (11) Underwriters Laboratories (UL)
 - (12) National Electrical Manufacturers Association (NEMA)

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- (13) American National Standards Institute (ANSI)
- (14) Illuminating Engineering Society of North America (IESNA)
- (15) All other Authorities Having Jurisdiction

1.04 REQUIRED SUBMITTALS

- A. Provide point by point photometric analysis calculations to document proposed lighting system performance to meet performance criteria. Point by point analysis to be provided for each area to be upgraded to LED. Simulations must be performed using approved industry standard software (e.g., DIALux, AGI 32)
 - (1) Specify the software name and version utilized for point-by-point luminance level calculations. Submit electronic files with hard copy report for County review.
 - (2) Provide documentation comparing the results from the model and the field verification measurements along with any necessary updates to the model resulting from the difference between the two (Section 1.08).
- B. Measurement and Verification Reports for existing and installed fixtures and emergency battery backup fixtures.
- C. Provide IES photometry files from for all new fixtures.
- D. Provide fixture specification sheets for all products and materials to include fixture photometric performance, iso-footcandle curves, lighting output data, and beam spread.
- E. Provide IES LM 79 test reports. This is a test of the fixture light output, energy use, and color spectrum.
- F. Provide IES LM 80 test reports. This is a test of the LED light source fixture components for depreciation over time.
- G. Provide IES TM 21 test reports. This is a test of fixture performance over time.
- H. Provide ASTM B117 3,000-hour minimum salt-fog test reports.
- I. Provide ANSI C136 3G vibration test reports.
- J. Product data for all devices, including efficiency, installation, and programming instructions.
- K. System Warranty
- L. Installation Plan
- M. Testing Plan
- N. Training Plan

1.05 FIXTURE DESIGN, PERFORMANCE AND DURABILITY

- A. This guideline applies to a complete lighting fixture and to the individual components (LED lamps, drivers, etc.) of a fixture.
- B. Luminaires require IP66 rated LED modules or better. This is a rating of protection against particles and water.
- C. Luminaire shall incorporate no fan or otherwise active cooling.
- D. Weight and shape of proposed fixtures (total quantity installed per mounting location

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to meet design criteria) shall be equivalent or reduced from those being replaced (total quantity removed per mounting location) such that static structural and wind loads are maintained or reduced. If this is not the case, installer shall provide structural design analysis showing the proposed configuration is sound.

- E. LEDs shall be rated for minimum of 50,000-hour life (L70, i.e., fixture output is reduced to 70% of its initial lumen output).
- F. Luminaire lifetime shall be 50,000-hour minimum lifetime (LED driver which also has a 50,000 minimum)
- G. Luminaire all have total harmonic distortion (THD) of no more than 20%
- H. Luminaires' LM 79 test reports shall support and correspond to the proposed overall system design and calculations with respect to light output, energy consumption, and color spectrum.
- I. Mounting system shall factor in and account for various bending and shearing stresses created by wind velocities, wind loads, on the light pole and the luminaire and wall mounted fixtures.
 - (1) Luminaire selection and mounting shall utilize historical values, analysis and research to determine the basic wind velocity for that geographic area.
 - (2) Where lighting poles are installed, luminaire selection and designs shall factor in natural frequency of light pole vibrations so that it doesn't coincide with the specific wind speed range.
- J. Vandal Resistance:
 - (1) Parts not easily removed without the use of special tools.
 - (2) Luminaires mounted at minimum height of 10 ft. above grade.
 - (3) Lenses to be made of tempered glass; high impact acrylic; polyacrylate; or polycarbonate.
 - (4) Metal gratings for protection of optical assemblies.
- K. For all projects where fixtures that may increase light pollution in surrounding communities/neighborhoods, the use of shields, fixture distribution types as defined by IESNA, relocating and or repositioning the fixtures shall be used to mitigate light pollution. Additionally light studies may be required to mitigate light pollution.
- L. All exterior lighting shall be controlled by photoelectric sensors and integrated into the building energy management system.
- M. Exterior lighting control panels shall be native BACnet, BTL listed, devices to match current County standards. The use of field servers or any protocol translators is not approved.
- N. Where hard wiring the control of exterior lighting is not feasible, native BACnet wireless devices operating at 900MHz may be used.

1.06 GENERAL CONSIDERATIONS

- A. Supplemental Guidelines for Exterior Area Lighting. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.
- B. All proposed fixtures shall be Light-emitting diode (LED) technology unless unique

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applications, approved by the owner prior to purchasing, require an alternative technology.

- C. This guideline applies to a complete lighting fixture and the individual components (LED lamps, drivers, etc.) that make up the fixture.
- D. All products and equipment shall factor in inventory management best practices. The County's practice is to minimize receiving, tracking, auditing, and managing equipment and items in its storage warehouse inventory by specifying and installing similar equipment in its facilities (e.g. same lamp or fixture). County operations and maintenance operations and efficiencies are improved by standardizing on one technology to be installed at multiple facilities.
- E. Where lighting also functions to facilitate the work of multiple disciplines, the lighting system will satisfy the operational requirements of each discipline in addition to the general lighting requirements.
- F. All products and equipment are required to be entered in the County's computerized maintenance management system, Corrigo.
- G. LED technology generally produces a higher quality of light and a more efficient distribution of lumens when compared to legacy technologies. With that in consideration, when legacy systems are retrofit with LED systems, ensure that the projects maintain the minimum maintained-illumination levels required for task(s) performed in the area being retrofitted. The intent is to maximize energy savings while minimizing negative glare impacts.
- H. For retrofit and renovation projects, new fixtures will typically use pre-existing mounting points. This limitation on re-location of fixtures may inhibit the system performance locations where baseline illumination is already underperforming. In these cases, reasonable effort should be made to design the new system to improve upon the existing system illumination.
- I. In locations where design illumination levels cannot reasonably meet recommended IES levels for existing operations, new fixture mounting points, by relocating or installing new luminaires, are required. This may include modification to existing mounting structures, including new mounting points involving poles, building mounting devices, or other exterior mounting designs. The County reserves the right to waive minimum illumination requirements on a location-by-location basis, with the exception for detention facilities.
- J. All lighting shall meet illumination levels according to IES recommendations for each space type.

1.07 FIXTURE LABELING

- (1) All fixtures shall contain labeling indicating line-voltage (e.g., 277V) of fixture including the maximum re-lamping wattage of the luminaire, including the ballast, if any.
- (2) Peel-off or Peel-down labels that are easily removed are prohibited.
- (3) Provide labeling templates for review and approval prior to procuring.

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1.08 FIELD VERIFICATION OF LIGHTING SYSTEM PERFORMANCE

- A. This section provides the framework for a standard measurement and verification (M&V) plan for lighting projects.
- B. Basic Considerations:
 - (1) Illuminance Meter
 - a) Purpose: To establish functional light levels for newly installed lighting technology
 - b) Accuracy:
 - 1) Use a meter with the highest overall accuracy possible.
 - 2) Set the measurement meter to the lowest available and applicable measurement range.
 - 3) When possible, use the same calibrated measurement meter, otherwise, use the same make and model of calibrated meter across all measurements (pre and post) and between all sites.
 - 4) Avoid taking measurements during periods of extreme temperature.
 - 5) Recommended practices for meter calibration
 - New meters should be purchased with National Institute of Standards and Technology (NIST) certification
 - Calibrate meters every two years, or according to manufacturer recommendation
 - If multiple meters are available, most recently calibrated units should be used to check accuracy of others.
 - c) Brand Examples:
 - 1) Konica Minolta
 - 2) Photo Research
 - 3) Cooke
 - 4) Extech
 - 5) Amprobe
 - 6) Solar Light
 - d) Documentation:
 - 1) Include specifications of measurement equipment used with the testing documentation.
 - (2) Meter “View” Considerations
 - a) Ensure the meter measures only the light being emitted by the technologies being tested

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- b) Conduct measurements during periods when potential obstructions can be avoided such as site occupants, cars, or equipment.
 - c) Ensure no objects are obstructing any light to the meter head.
 - d) If a measurement location is partially or fully blocked by a permanent obstruction, eliminate this measurement.
 - e) Take measurements at the task plane. For measurements in exterior areas, the task plane will be ground level. Ensure the sensor is parallel to the task plane.
- (3) Marking and mapping measurement locations
- a) Measurements must be taken at the same location for baseline (or simulated point) and post-installation. Create a grid map of the measurement locations referencing permanent site features. During field measurements, use non-permanent markers, such as cones, to delineate reference points and augment the permanent site features.
- (4) Additional Documentation
- a) Provide a permanent record of the selected measure point locations.
 - b) Take pictures of site conditions, meter setup, and measurement point layout.
 - c) Record the time and ambient temperature at the start and finish of taking measurements.
- C. Exterior Measurement Procedures
- (1) Set Up the Measurement Grid:
- a) Spacing between measurement points:
 - 1) Measurement spacings must be uniform in both directions.
 - 2) The maximum distance between measurement points must be half the height of the mounting location or 45 feet, whichever is smaller.
 - 3) If mounting locations are spaced less than 45 feet apart, spacing between measurements should include at least three measurement points between the mounting locations in both directions.
 - 4) A center measurement point between two mounting locations must be an equal distance from each location.
 - 5) Software models used to simulate point-by-point photometric analysis typically generate a finer grid spacing. If the required submitted photometric simulations identify areas of concern where light levels may not be adequate, perform additional lighting measurements in those areas.
 - b) Record measurement grid locations including dimensions from surrounding mounting locations or other structures.

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- c) Open Areas: The measurement grid should completely encompass at least four poles that represent the typical layout and spacing of poles
 - d) Site Perimeters/Areas Adjacent to Building: Establish the test area measurement grid in a typical perimeter or building edge area.
- (2) Measure and Record Illuminance
- a) Minimize the effects of other light sources and weather conditions on the measurement results:
 - 1) Schedule measurements for when the moon phase is at half or less to eliminate moon glow as a variable in the measurements.
 - 2) Measure the ambient lighting (e.g. moonlight, sky glow) in an area shielded from all site lighting. If the ambient lighting is significant, subtract it from other measurements.
 - 3) Take measurements at a time when particulates in the air are minimal. Consider weather conditions that may obscure the light between the source and the meter head such as rain, fog.
- D. Post-Installation Documentation Activities
- (1) The project documentation should include as-builts and specifications for the technologies (lighting drivers/ballasts and lamps) installed as well as the expected lighting illumination levels in the areas specified.

1.09 END OF DOCUMENT