



# EPC-15-085: Ongoing Maintenance and Retrocommissioning Plan

## *City of San Diego Public Library ZNE Demonstration Project*

*Prepared for*  
California Energy Commission

*Prepared by*  
Center for Sustainable Energy

January 2021



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# I. Introduction

The Center for Sustainable Energy (CSE) and the City of San Diego developed this *Ongoing Maintenance and Retrocommissioning Plan* as part of the California Energy Commission (CEC) EPIC demonstration project, EPC-15-085.<sup>1</sup> This project is a demonstration of zero net energy (ZNE) and integrated demand-side management strategies that includes installing, testing and measuring energy efficiency improvements in three San Diego libraries (Point Loma/Hervey, Serra Mesa-Kearny Mesa and Valencia Park/Malcolm X) with the goal of achieving ZNE or near-ZNE. These libraries are owned and operated by the City of San Diego, and this plan outlines ongoing maintenance and retrocommissioning recommendations following the installation of, building automation systems (BAS), plug load management devices, light-emitting diode (LED) lighting, heating, ventilation and air conditioning (HVAC) and lighting controls, kiosks to display energy dashboards, and submeters. It also outlines recommendations to continue to report and analyze energy use at the libraries after project completion.

# II. Recommended Maintenance

The installed energy efficiency measures will require maintenance to ensure they continue to operate efficiently and maximize the lifespan of the equipment. HVAC units were not installed measures for this project, but HVAC controls were installed. Preventative HVAC maintenance will be important to maintain the effectiveness of installed HVAC controls, and HVAC is the highest consuming end-use at all the libraries. Photovoltaic solar systems that were installed as part of the project through a power purchase agreement will follow maintenance recommended by the power purchase provider. Recommendations for each subsequent measure are detailed in this section.

## BAS and Plug Load Management Devices

Following the BAS installation, the City of San Diego Facilities Department entered a separate annual software maintenance contract with the provider, Climatic, for the new equipment. They will provide manufacturer-released patches and updates, on a quarterly basis, to the Tridium Niagara software and JACE devices at all three libraries. This contract also includes the cost of the annual software subscription for Tridium Supervisor and the licensing renewal cost per JACE. Software support was already included for the installed plug load management devices by BERT® Plug Load Control for three years following the completion of the project and is therefore covered for that time period. However, there were several plug load management devices listed in the Report of Installation Activities<sup>2</sup> that

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<sup>1</sup> *Energy Innovation Showcase*. 2020. California Energy Commission.  
<http://innovation.energy.ca.gov/SearchResultProject.aspx?p=30919&tk=636842721307653350>

<sup>2</sup> *Report of Installation Activities*. 2020. Center for Sustainable Energy:  
[https://sites.energycenter.org/sites/default/files/docs/microsites/sdzn3/Final\\_EPC-15-085\\_Report\\_of\\_Installation\\_Activities.pdf](https://sites.energycenter.org/sites/default/files/docs/microsites/sdzn3/Final_EPC-15-085_Report_of_Installation_Activities.pdf)

could not be connected without a boost in Wi-Fi signal. Once addressed, the remaining devices can be installed and connected to BACnet and the BAS.

Additional preventative maintenance services were recommended four times a year (quarterly) for the BAS main operator workstation, network and global control modules. The preventative maintenance includes analyzing the number of operator or system change occurrences for impact on performance, analyzing network communication, reviewing trend and alarm logs, monitoring LED sequencing, inspecting wiring for signs of fraying, removing excessive dust from internal surfaces. The City of San Diego should consider adding these additional maintenance services.

## LED Lighting

The LED lighting installer, ABM, recommended to clean fixtures on a regular basis (about every 3 months) to prevent failures. Dust buildup and precipitation can cause the new lighting to malfunction. They noted to not jolt or knock the lighting fixtures, which could cause the wiring connections to become disjointed and malfunction. Additionally, no one should touch lighting directly without proper safety gloves that do not conduct electricity. Other than these potential hazards, LED lighting should last for at least five years. If a light is not working properly, ABM will provide assistance under the five-year factory warranty . Outside the warranty period, ABM or other lighting installers/providers will need to provide diagnosis and repairs if the lights stop functioning properly.

## Kiosks and Submeters, HVAC and Lighting Controls, and HVAC Units

The City of San Diego has an additional seven-year pre-paid subscription (until 2028) with AcuityBrands® to maintain the energy dashboard displays. The Olea Kiosks should be cleaned using the appropriate Olea [cleaning guidelines](#). Climatec and ABM did not note preventative maintenance for HVAC and lighting controls or submeter equipment for all libraries. However, during commissioning and retrocommissioning of the HVAC controls, the following maintenance activities were recommended for HVAC units at all libraries and then for the individual library's needs.

### All Library Units

1. Change air filters for all applicable HVAC units on regular basis, every three to four months. This causes healthier indoor air quality for library occupants, increased efficiency for air conditioner (AC) units, and reduced energy cost for the supply fans operations (with clean filters compared to dirty filters).
2. All AC, Chiller (CH) and air handler (AH) units should have regular maintenance performed on them as identified in the operations and maintenance manuals for each unit, which can be found online (example links included) or placed at the unit. (Tables 1-3).

### Point Loma/Hervey Units

1. Inspect and repair non-operational AH-6 and all air handling units with alarms (AH-1, AH-4, AH-6, AH-8).
2. Inspect alarm for fan coil/coil unit (FC/CU) split system.
3. Inspect and repair boiler.
4. Replace chiller (CH), already anticipated for June 2021, and connect to BAS.
5. Inspect slow connections to AH controllers and Trane controller, observed at AH-4.
6. Install and air temperature sensor to the existing Trane controller to operate economizers for AH-1, AH-2, AH-3, AH-7, AH-8, AH-9, and AH-10 to achieve greater energy savings.

Unit ID	Manufacturer	Model	Vintage	Notes
AH-1	Petra	<a href="#">PAHHC40</a>	2002	Young Adults, Music
AH-2	Petra	PAHHC40	2002	Children's Library Art Area
AH-3	Petra	PAHHC40	2002	Children's Reading/Story Area
AH-4	Petra	PAHHC24	2002	Seminar Room Classroom
AH-5	Petra	PAHHC32	2002	Multimedia Tel/Data
AH-6	Petra	PAHHC80	2002	Adult Stacks - South Reading
AH-7	Petra	PAHHC40	2002	Adult Stacks - North Circulation
AH-8	Petra	PAHHC40	2002	Seminar 220, Break Room Office, Workroom
AH-9	Petra	PAHHC40	2002	Rotunda, South Entry, Restrooms 201/202
AH-10	Petra	PAHHC80	2002	Community Room
CH-1	Evapco	<a href="#">LSCB-135</a>	2002	Central unit, whole building
FC-1	Trane	TWE018C1408	2002	Indoor Fan Section
CU-1	Trane	TTB012C100A2	2002	Outdoor Section

**Table 1:** Point Loma/Hervey Air Handler, Chiller and Fan Coil Units

### Serra Mesa-Kearny Mesa Units

1. Inspect slow connections to AC unit controller and Trane controller itself, observed in AH-1, AH-6 and AH-8.
2. Inspect and repair economizer dampers as identified in this report. Economizers were disabled on AH-1 and AH-5, and an alarm for AH-2).
3. Install an air temperature sensor to the existing Trane controller to operate economizers for AC-7 and AC-9 to achieve greater energy savings.
4. Inspect and repair or reinstall missing supply air sensors as identified in this report, observed in AC-3 and AC-4).

Unit ID	Manufacturer	Model	Vintage	Notes
AC-1	Trane	<a href="#">YHC072</a>	2005	Community Rm 110
AC-2	Trane	YHC072	2005	Seminar Rms
AC-3	Trane	YCD151	2005	Children's Rm 131
AC-4	Trane	YCD151	2005	Stacks
AC-5	Trane	YHC072	2005	Circulation
AC-6	Trane	YHC060	2005	Staff Work Rm
AC-7	Trane	YCP024	2005	Tele. Rm 135
AC-8	Trane	YHC036	2005	Comp. Rm 124
AC-9	Trane	YHC092	2005	Reference Rm 126
AC-10	Trane	YHC036	2005	Reading Rm 129

**Table 2:** Serra Mesa-Kearny Mesa Air Conditioning Units

### Valencia Park/Malcolm X Units

1. Inspect and repair non-operational AC unit furnaces identified, AH-1, AH-3, AH-6, AH-7, and AH-8.
2. Inspect and repair supply fan for AC-9.
3. Inspect and recalibrate or replace outside air (OSA) sensor at AC-4.
4. Rebalance airflow for AC-2 serving the computer lab, Lobby and office. Check refrigerant charge and pressure. The facility staff indicated the lab with approximately 20 computers, printers, and people often gets hot in the afternoon indicating the unit fails to satisfy the peak cooling load.
5. Inspect and repair duct smoke detector (DSD) for AC-2, which has no cover and generates nuisance alarms.
6. Inspect and rebalance airflow for AC-5 serving the computer lab. Check refrigerant charge and pressure. The facility staff indicated the lab with approximately 20 computers, printers, and people often gets hot in the afternoon indicating the unit fails to satisfy the peak cooling load.
7. Provide a designated smoking area away from the entrance and AC unit outside air inlets facing the front of the building. The library staff indicated that sometimes they could smell smoke inside the library.
8. Inspect and repair economizer dampers for AH-1.
9. Inspect frequently blown circuit breaker or fuse for chiller CH-1. Create routine maintenance schedule for the chiller and its pump.

Unit ID	Manufacturer	Model	Vintage	Notes
AC-1	Carrier	<a href="#">48TCDD14</a>	2014	Music/Seminar
AC-2	Carrier	48TCDD14	2014	Multimedia
AC-3	Carrier	48HCDD08	2014	Staff Area
AC-4	Carrier	48HCED11	2014	Read San Diego
AC-5	Carrier	48HCLA05	2014	Computer Lab
AC-6	Carrier	48TCDD17	2014	Main Library
AC-7	Carrier	48TCDD17	2014	Main Lib. West
AC-8	Carrier	48TCDD17	2014	Main Lib. East
AC-9	Carrier	48HCLA06	2014	Lobby
AC-10	Carrier	48HCLA06	2014	Lobby
AC-11	Carrier	38GVC024---3	2013	Teen Tech Center
AH-1	Carrier	39LB-18	1995	Multipurpose room
CH-1	Carrier	30GT025-610	1995	Multipurpose room

**Table 3:** Valencia Park/Malcolm X Air Conditioning Units, Air Handler and Room Chiller

### III. Ongoing Retrocommissioning

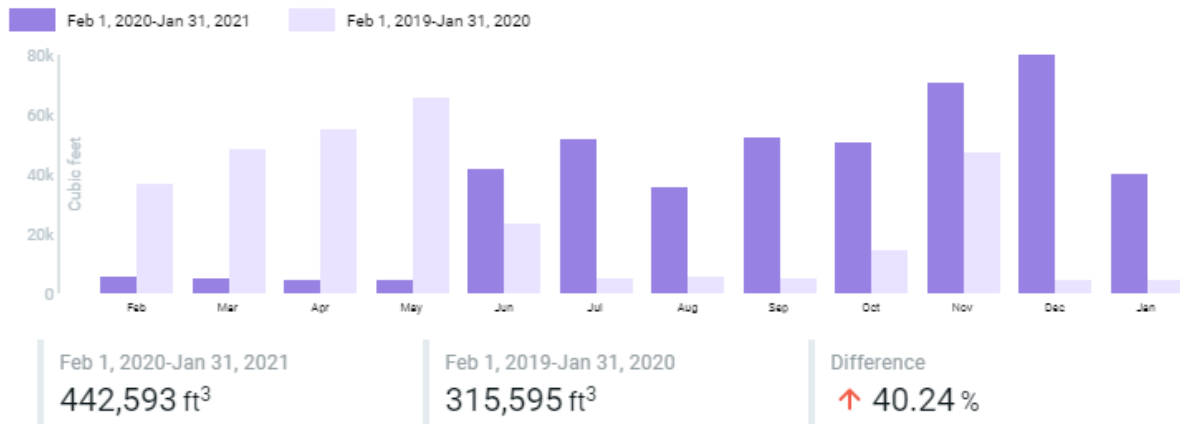
Retrocommissioning is the readjustment of existing buildings and systems so they will operate optimally and efficiently by way of set points, schedules, sequencing, and controls programming. Retrocommissioning can reduce operating costs and improve functionality of building systems that have deviated from their original design or operations. Even during the first nine months of measurement and verification of the installed energy efficiency measures there was a large increase in gas use at the Point Loma/Hervey Library. Retrocommissioning is now recommended in quarter one of 2021 and in the future, it is recommended about every three-five years for commercial buildings. It is also recommended if there are irregularities found that can be attributed to set points, schedules, sequencing, and controls programming. Furthermore, the City of San Diego should consider optimal demand shifting and shredding adjustment when retrocommissioning.

#### **Point Loma/Hervey Library Retrocommissioning Recommendations**

First observed in the BuildingOS energy dashboard for the Point Loma/Hervey Library starting in June 2020, a large increase in gas usage continued through January 2021 (Figure 1). HVAC controls and units at the library were serviced in September 2020 to identify and fix the issue but the increase in gas usage has continued through January 2021.



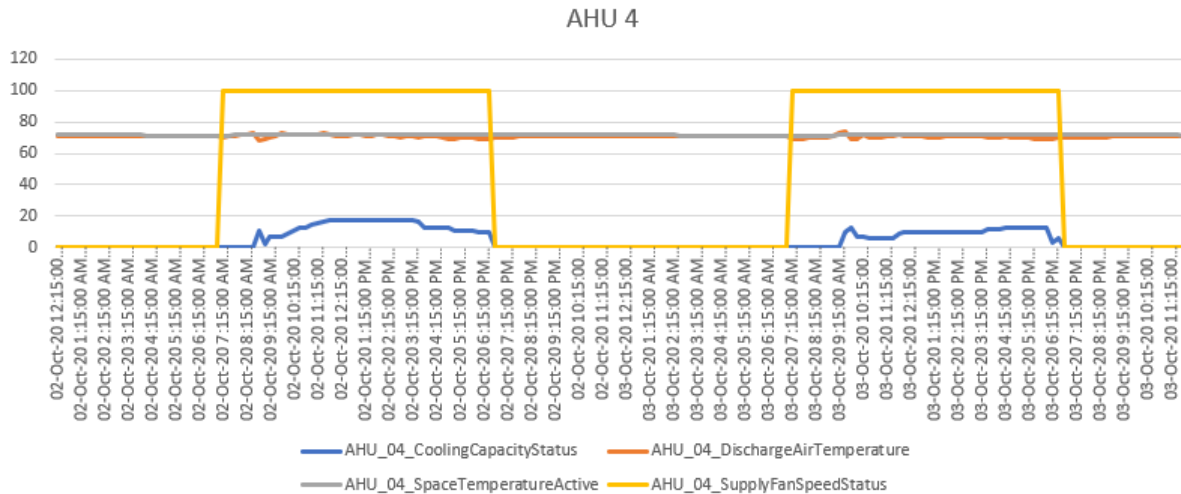
## Year over year Natural Gas Consumption / Last 12 months compared to previous period



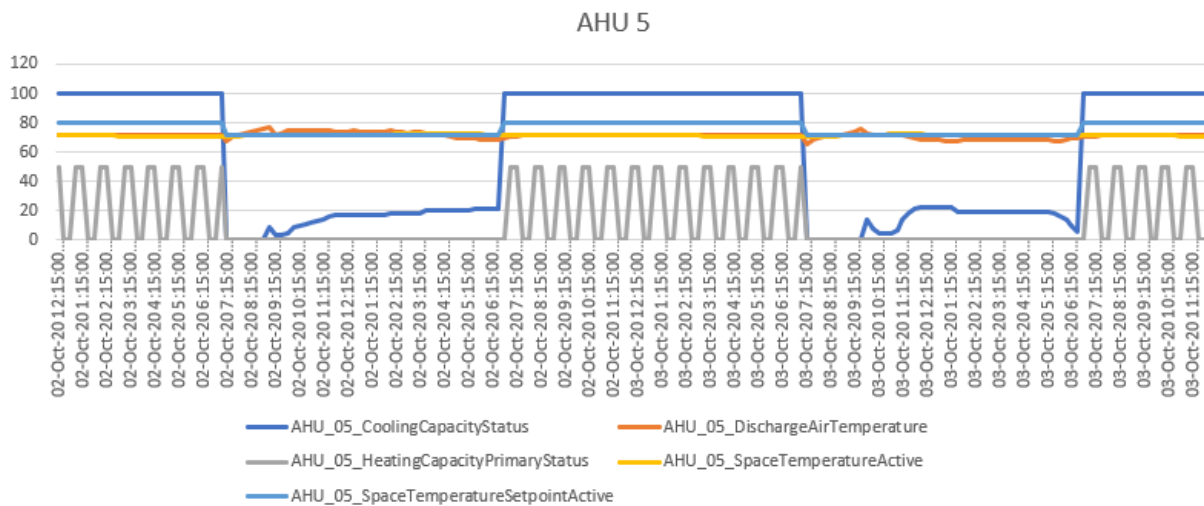
**Figure 1:** Point Loma/Hervey Year over year Natural Gas Consumption  
(February 2020 – January 2021)

A deeper analysis was completed with the Point Loma/Hervey BAS data to identify the issue and the findings were as follows.

- There are five air handler units (AHU)'s that have heating turning on during unoccupied hours (AHU 1, 3, 5, 8 and 9). Figure 2 shows how an AHU that is running as expected (AHU 4), while Figure 3 shows show an AHU that has heating coming on during unoccupied hours (AHU 5).
- Most units have a value that seems to be reporting inaccurately (i.e. Cooling Capacity at 100% during unoccupied times when unit is off). Reporting values for each unit are static and not reporting properly or are defaulting to 100%, instead of 0% when off.
- AHU 1 and 10 look to be cooling during some nighttime hours.
- Space temperatures for the units are mostly between 72-74 degrees Fahrenheit, which is good. However, AHU-1 's space temperature does drop to 61 degrees Fahrenheit indicating that cooling might be running during night hours.



**Figure 2: Point Loma Hervey AHU 4 Operation Analysis (October 2-3, 2020)**



**Figure 3: Point Loma Hervey AHU 5 Operation Analysis (October 2-3, 2020)**

### Optimal Demand and Load-shifting Recommendations

The project compared the 2017 baseline electric time-of-use (TOU) energy consumption data to the 2020 post-retrofit measurement and verification electric TOU data from May to October to identify if the retrofits decreased energy consumption and demand during high-energy use (on-peak) times as defined by San Diego Gas and Electric® (Tables 4-6). It was found all three libraries have less on-peak (4 p.m.- 9 p.m.) and off-peak (9 p.m.-12 a.m. and 6 a.m. – 4 p.m.) consumption, and some consumption was shifted to super off-peak (12 a.m. – 6 a.m.). This is a good result because it is the least expensive and greenhouse gas emitting time period.

As for optimal demand and load shifting/shedding, it is again recommended for retrocommissioning controls and schedules to make sure all systems are off when they should be, even if this takes an after-hours visit to confirm. HVAC pre-cooling/heating prior to occupied morning hours or the 4 p.m. on-peak TOU period could be programmed, but this would require additional approval from the City of San Diego since space temperatures could vary outside of the 70-74°F range and was not included in energy models.

Point Loma/Hervey		On Peak		Off Peak		Super Off Peak	
Qtr.	Month	2017	2020	2017	2020	2017	2020
<b>Q1</b>	May	26.4%	21.3%	54.7%	50.1%	18.9%	28.6%
<b>Q1</b>	June	25.4%	22.3%	55.4%	49.3%	19.2%	28.4%
<b>Q1</b>	July	24.0%	22.3%	54.1%	50.0%	21.9%	27.6%
<b>Q2</b>	Aug	24.4%	22.2%	56.0%	48.5%	19.7%	29.3%
<b>Q2</b>	Sept	25.0%	22.2%	52.2%	49.1%	22.7%	28.7%
<b>Q2</b>	Oct	26.9%	22.2%	52.7%	47.5%	20.4%	30.3%
	<b>Total</b>	<b>25.3%</b>	<b>22.2%</b>	<b>54.2%</b>	<b>48.8%</b>	<b>20.5%</b>	<b>29.0%</b>

**Table 4:** Point Loma Hervey 2017 Vs. 2020 Time-of-Use Breakout

Serra Mesa		On Peak		Off Peak		Super Off Peak	
Qtr.	Month	2017	2020	2017	2020	2017	2020
<b>Q1</b>	May	26.9%	24.5%	52.4%	56.2%	20.7%	19.3%
<b>Q1</b>	June	25.0%	22.2%	54.5%	58.1%	20.4%	19.7%
<b>Q1</b>	July	25.1%	25.4%	52.7%	48.3%	22.2%	26.3%
<b>Q2</b>	Aug	26.6%	24.4%	54.8%	47.1%	18.6%	28.6%
<b>Q2</b>	Sept	26.4%	24.2%	51.9%	48.9%	21.7%	26.9%
<b>Q2</b>	Oct	27.0%	23.3%	52.6%	48.4%	20.4%	28.2%
	<b>Total</b>	<b>26.2%</b>	<b>24.1%</b>	<b>53.2%</b>	<b>49.9%</b>	<b>20.7%</b>	<b>26.0%</b>

**Table 5:** Serra Mesa-Kearny Mesa 2017 Vs. 2020 Time-of-Use Breakout

Valencia Park		On Peak		Off Peak		Super Off Peak	
Qtr.	Month	2017	2020	2017	2020	2017	2020
<b>Q1</b>	May	31.7%	27.9%	50.0%	55.8%	18.3%	16.3%
<b>Q1</b>	June	31.5%	25.9%	51.1%	59.4%	17.4%	14.6%
<b>Q1</b>	July	30.5%	28.2%	50.7%	53.2%	18.7%	18.6%
<b>Q2</b>	Aug	31.0%	26.6%	52.6%	46.6%	16.4%	26.8%
<b>Q2</b>	Sept	31.5%	26.4%	50.8%	49.9%	17.7%	23.7%
<b>Q2</b>	Oct	31.1%	26.4%	51.2%	49.7%	17.6%	23.9%
	<b>Total</b>	<b>31.2%</b>	<b>26.8%</b>	<b>51.1%</b>	<b>51.3%</b>	<b>17.7%</b>	<b>21.9%</b>

**Table 6:** Valencia Park/Malcolm X 2017 Vs. 2020 Time-of-Use Breakout

## IV. Energy Use Monitoring, Reporting and Analysis

It is recommended to share the project's M&V and Cost Benefit reports for historical energy consumption, and share access to view the three library energy dashboards with City of San Diego library facility staff to provide high level, near real-time, daily, weekly, monthly and annual energy use consumption charts/reports. Of note, only the HVAC data is currently reported using a calculation with utility data and on a 24-48-hour reporting lag unless the utility data interface is upgraded or BuildingOS/Tridium compatible HVAC submetering is installed. Review of the energy consumption data is to help quickly identify if energy consumption spikes occur, if there is another energy use irregularity at the libraries and provide current resource utilization for budgeting.

If an energy use spike or irregularity occurs, there are vendors such as Climatec that offer diagnosing and servicing HVAC and building system issues and telephone or online support. They can provide energy submetering inspections if needed. Furthermore, beyond initial trainings on the installed measures conducted in April 2020, they offer operator training services for BAS and annual system and service reviews to discuss the services performed during the past year and to recommend improvements and options to enhance system performance, resolve operational problems, and to meet changing needs and objectives.