Scope of Work
for
City of Ridgecrest

Energy Modernization and Efficiency Improvement Project

Prepared by:
Southern California Trane

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Scope of Work -New Central Plant with Ice Storage

6.1 List of Trades and Professions on this Job

1. Mechanical Contractor – Water Side
2. Mechanical Contractor – Air Side
3. Division 16 AC Electrical Subcontractor
4. Division 16 DC (Solar) Electrical Subcontractor
5. Controls Electrical Subcontractor
6. General Contractor
7. Test and Balance Subcontractor (TAB)
8. Window Retrofit Subcontractor
9. Mechanical Contractor - Sprinkler

6.2 General Project Information

This is a design-build project where Trane will be working directly for the Owner and acting as the Construction Manager. Trane will also be functioning as the Controls Subcontractor. Trane will furnish all major pieces of Mechanical Equipment listed on Drawings M0.1 and M0.7 and as called out in the Electrical Specifications (Solar Panels). Trane will also provide startup on all Trane provided equipment. All other work shall be subcontracted out.

Trane is soliciting bids for the work identified herein by the above List of Trades. Job walk date is Friday January 23rd. Bid due date is noon Monday February 9, 2009. All bids must be in compliance with the RFP issued for this work.

The 80 % Engineered plans sets dated 1/15/09 and the RFP shall form the basis of subcontractor bids. This Statement of Work (SOW) is intended to clarify how the division of trades will be accomplished.

Trane intends to submit a final detailed Statement of Work (SOW), along with firm fixed Guaranteed Maximum Pricing (GMP) and an estimate of Energy Savings to the City Council on March 4th. 100% plans sets will be finalized after selections of Subcontractors is completed to allow for final detailed design input.

Estimated date of Contract Award to Trane is approximately March 10. Selection of Subcontractors is expected by April 1, 2009 subject to Trane receiving Notice to Proceed. Final Engineering is expected to be complete by May 1, 2009. This is contingent on award of Contract by the City.

If clarifications or questions regarding any of the plan sets or bid instructions are necessary, they shall be forwarded to the Trane Project Manager in written RFI format. Please allow three days for answers. Verbal instructions are not contractually binding. The Trane Project Manager is:

Mike Harmon
Project Manager
Trane Company
17760 Rowland Street,
City of Industry, CA 91748
(626) 392 2294
davidmike.harmon@trane.com

6.3 Engineering of Work

Trane shall provide a 100% set of stamped and Engineered plans for the work. The plans shall include all mechanical, electrical, plumbing (MEP) as well as structural and control elements necessary for a complete turnkey project.

A set of stamped 100% plans and specifications shall be produced within eight weeks from award of contract to Trane and submitted to the City for all plan checks and permits.

Note: The central plant, solar Photo-Voltaic(PV) equipment and designs described herein are conceptual in nature. They are intended to convey a close approximation of the functionality and appearance of the engineered plans. These descriptions are intended to serve as a guide for defining inclusions and exclusions for Subcontractor pricing. In the event of conflict between the concept and the engineered plans, the engineering designs shall supersede and take precedence over what is described herein.

No work shall be performed until Building Department Approvals are obtained, unless specifically directed by the Owner.

Upon approval of plan sets, shop drawings, cut sheets and submittals shall be prepared by all trades. Submittals to the Owner will be required within two weeks of final plan set distribution.

All equipment and product cut sheets shall require approvals by the Owner prior to ordering any material. All equipment installed as part of this scope shall be installed in accordance with manufacturer's installation guidelines and the consulting Engineer's design. In the event of a conflict in the drawings or need for a clarification, all issues shall be referred to the Trane in a written Request for Information (RFI) format for resolution.

Trane shall arrange for the performance of all Tests and Inspections per the procedures designated by the Engineer of Record and the City. Trane shall pay the expenses associated with the necessary Inspections. Inspection records shall become the property of the Owner upon completion.

All trades shall furnish at the completion of the project a complete set of as- built shop drawings and six (6) copies of Operation and Maintenance manuals, start up and commissioning reports, and all other items listed under this scope of work. All drawings shall be in AutoCAD format.

6.4 Central Plant Work

It is proposed to install a new Central Plant at the Civic Center Complex. The central plant will produce all cooling for both the City Hall and the Community Center. This would be done using water cooled chillers, pumps and cooling towers. Chilled water would be piped to both buildings to new air handlers and fan coil units that would replace the existing package units.

The Central Plant will be installed in a new steel building next to the parking lot on the NW side of City Hall. The exterior of the building will be painted to match the façade of City Hall. The building will have a flat roof and two roll-up doors facing into the Police Parking lot for service access.

This building will house the Central Plant (two new chillers, ice storage tanks, all heat exchangers and pumps). All Chillers, Heat Exchangers, Cooling Towers, Ice Storage Tanks,

glycol solution and Pumps will be furnished by Trane. The cooling towers will be located adjacent to the building. (Receiving, storage and installation by Mechanical/ Water side)

The building will also provide two new rooms for additional storage for the Civic Center complex and for Police Impound.

Solar PV panels (complete) will be mounted on the roof of the new building. (received, stored and installed by GC)

The chillers will be used to produce ice in the storage tanks during SCE non-peak hours. Chilled water will be produced from the ice reserve during the day. The chilled water will then be piped and pumped to new air handler units at both the Community Center and the City Hall.

The new chiller plant is based on using ice storage. There will be fifteen (15) ice storage tanks located next to the central plant. Each tank is rated at 160 ton-hours of cooling. These will provide approximately 2400 ton-hours of cooling reserve. These will be located behind an 10' block wall. (fencing, walls by GC)

New variable frequency drives (VFD's) will be installed on all fan motors larger than 5hp. These will be furnished along with startup by Trane. (Receiving, storage and installation by Electrical Contractor.)

All piping systems and equipment and insulation shall be received, stored installed by the water side Mechanical Contractor. All new plant electrical 110 VAC or greater shall provided and installed by the Division 16 AC Electrical Contractor. Air Supply and Exhaust equipment and systems shall be by the Mechanical Contractor/Air Side.

Controls electrical subcontractor shall be responsible for all low voltage controls electrical work including receiving and storage of devices.

New fire sprinklers shall be installed by the Fire Protection Contractor.

Interior and exterior lighting shall be provided and installed (by the Division 16 AC Electrical Contractor).

In order to provide cooling for the equipment inside the building, a fan coil unit and roof top ventilators will be installed. Trane to provide startup (Installed by the water side Mechanical Contractor)

Appurtenant items such as eye wash station and shower, shall be added as part of the installation (Provided and installed by the water side Mechanical Contractor).

480VAC electrical service shall be brought into the plant per the electrical Drawings in a trench to the plant. The feeds shall be terminated in a new electrical distribution center that will serve the new equipment. Wiring shall be run to each individual end device. All new equipment will have local disconnects present and furnished per plans. (Installed by the Division 16 AC Electrical Contractor).

New domestic water service and sanitary drains shall be installed at the central plant. (Mechanical/Plumbing is responsible for all trenching).

Water service to the towers shall be sourced from the well located on the NW corner of the property. Mechanical/Plumbing is responsible for all trenching and installation..

A new sump and pump for the sanitary drain shall be provided with a pressurized discharge to the sanitary sewer located on Warner Avenue. (GC responsible for sump and water side Mechanical/Plumbing to provide excavation and installation of equipment and lines).

Storm Drains furnished by and installed by Mechanical/Plumber

Storm Down Spouts furnished and installed by General Contractor.

No gas service shall be run to the plant.

A refrigerant monitor and alarm system, complete with horns, strobes, break glass switches and evacuation fan shall be installed to make the central plant fully ASHRAE 15 compliant. Trane will furnish and do startup. (Installed by the Division 16 AC Electrical , piping by water side Mechanical Contractor and any air ducting by Mechanical Contractor/Air side)

A new chilled water (CHW) loop shall be piped via a four foot deep trench from the new plant to the City Hall and Community Center. This trench will also include 2" PVC conduit for controls (wiring at a later date).The new piping shall be run from the plant underground to both buildings and up the sides of the existing structures. The Electrical conduit will have a line from the Central Plant to the Civic Center and a separate line from the Civic Center to the Community Center. Decorative chaises that match the existing facades shall cover the pipe runs up the exterior walls (Mechanical/Piping responsible for all trenching and installation of pipe). Chaises by General Contractor). (Underground conduit by Mechanical/Electrical Div. 16 Contractor)

The CHW piping, supported and insulated, shall be looped around the roof of each building inside the parapet walls to each of the new air handler units (water side Mechanical .

Certified Water balance shall be by the TAB contractor contracted to Trane.

Trane shall provide all final commissioning services. No 3rd party commissioning will be used. Subcontractors will be required to assist as needed.

The north side parking lot of the building shall also be reworked at the same time to provide for enclosed and secured police parking. A new 8' or 10' block wall shall be added around the new secured parking perimeter. The pole lights and planter areas on the interior of the wall shall be demolished and converted to parking area. Some existing lot area shall be demolished and the lot re-graded per plans. The remaining lot areas shall be re-coated with slurry and the area re-striped. New concrete swales shall be installed. Two automatic motorized gates shall be installed for motorized traffic, along with new people gates. New perimeter lighting shall be installed on the walls building walls and under carports. The existing radio tower and utility housing area and emergency generator shall be left "as-is". (Division 16 Mechanical/Electrical)

The General Contractor will be responsible for all parking lot demolition work, patching, grading and excavation, building footings and slabs, procurement of steel and steel erection, roofing, windows and doors. He will also be responsible for all soil compaction, curbs, lot asphalt re-surface, lot re-striping and perimeter block walls, gates and site security fencing..

Emergency power provisions (if required) per the plans.

6.5 BAS Control System

All low voltage electrical installation work in this section is to be performed by Controls Electrician. Trane to provide all controls parts and startup of controls.

A Johnson Controls, Inc (JCI) certified Controls contractor will be separately contracted by Trane to re-commission existing controls on the existing VAV boxes in the City Hall building and to provide integration to the Trane workstation.

See Trane Controls Engineering documentation for full list of bid instructions and design details.

6.6 Heating Hot Water System

Three new modular high efficiency boilers will be installed on the roofs of the Civic Center and the Community Center. Heating Hot Water (HHW) piping shall be run around the roofs of each building in the same rack as the chilled water piping. (By Water side Mechanical) New gas service to the boilers shall be installed (by the Plumbing side Mechanical Contractor).

All structural steel supports from parapet walls and boiler platforms shall be installed by the Mechanical Contractor.

The three existing Modine Furnaces on the Civic Center building will be demolished (by the air side Mechanical Contractor). Division 16 AC Electrical subcontractor responsible for electrical disconnect of old units, and installing electrical service to new boilers and pumps.

All gas piping branches to the existing units will be removed and capped at the mains (by the plumbing side Mechanical Contractor).

Flue venting by air side Mechanical Contractor

Equipment and Piping ID by mechanical trade doing work.

6.7 New Air Handlers

All package units on the roofs of both buildings will be replaced with new air handler units by the air side Mechanical Contractor (All AHU's, curbs and control valves will be provided by Trane). Refrigerant removal and disposal by air side Mechanical Contractor. City to retain all salvage rights.

Air side Mechanical Contractor to set curbs and to provide additional structural supports (if required) and provide roof repair. Air side Mechanical Contractor to provide for crane lifts and setting units and all duct transitions.

Schedule for lifts is TBD so Air side Mechanical Contractor and Division 16 AC Electrical subcontractor must clearly provide assumptions and conditions for install as part of bid proposal.

The new air handler units will have chilled water coils for cooling and hot water coils for heating. Hot water will be supplied by the new local hot water boilers located on the roofs of the buildings. Piping and valve installation by water side Mechanical Contractor.

Division 16 AC Electrical subcontractor responsible for electrical disconnect of old units, downsizing circuit breakers at MCC and electrical re-connect of new units. Use of existing conduit and wire is anticipated.

New variable frequency drives (VFD's) (furnished by Trane)(Trane to provide startup) will be installed on all fan motors larger than 5HP by the Division 16 AC Electrical subcontractor. Division 16 AC Electrical subcontractor to furnish and install starters and disconnects for units with less than 5 HP fan motor.

New smoke detectors will be installed (by Controls subcontractor) per Controls Engineering drawings. Smoke Detectors furnished as per drawings.

New general exhausts fans equipped with VFD's will be used to maintain the building static at proper levels per plan details. These are to be roof mounted. Trane to furnish all Exhaust Fans, curbs and start-up services. Mechanical Contractor to set curbs GC to provide roof repair. Air side Mechanical Contractor to install and Division 16 AC electrician to wire. Controls electrician to provide all control conduit and wiring.

New condensate drain lines shall be run from the drain pan of each unit to the nearest roof drain that serves the existing package units. Use existing roof pipe supports or provide new as required. (Wet side Mechanical Contractor).
Exclude correction of any code non compliance regarding the roof receptors.

Equipment and piping ID by trade doing work.

Electrical Roof penetrations and repair by Electrical Contractor.

6.8 City Hall and Community Center Re-ducting and Re-Air Balance

1. A recent survey air balance study has been done on both buildings. Copies of this are available on request from the Trane Project Manager.
2. Air side Mechanical Contractor to perform all air side demolition per call out on plans.
3. Air side Mechanical Contractor to survey duct systems for all leakage and disconnected duct work . All leaks and disconnects to be repaired. For bid purposes, call out all assumptions and allowances used for this purpose as a BREAKOUT number.
4. Air side Mechanical Contractor to install all new ductwork, insulation, drops, grilles/diffusers and VAV Boxes per plan callouts.
5. Division 16 AC Electrical subcontractor to install power to new VAV Boxes. Transformers provided and furnished with VAV by Trane.
6. TAB contractor to perform a final Certified Air Balance on all air handlers and fan coils, vav's and all individual supply and return registers. Adjust each drop to the correct air flow specified on the Engineered Plans. Work in conjunction with Trane to set proper air flow values for DDC controls.
7. A JCI authorized subcontractor (direct to Trane) will re-commission the existing JCI VAV box controls and install controls on new dual duct boxes. The JCI Controls will be integrate to the new Trane Summit Front End so all information is available at a single location.

6.9 Covered Parking and Solar Electrical at Civic Center

A Photo-Voltaic (PV) solar power system will be installed at the Civic Center. To do this, a covered parking structure (s) with solar panels on the roof will be installed in the parking lot areas and on the roof of the Central Plant. The covered parking will consist of a steel frame structure with roof purlins to support the solar panels.

The following trades shall be responsible for installation of system components as specified below:

1. General Contractor to provide all site demolition per plan call outs.
2. Division 16 AC Electrician to set and install one inverter. Supply and install all wire and conduit to for full AC side installation per plan callouts.
3. Division 16 AC Electrician to provide and install all new under canopy lighting per callouts.
4. Electrical Contractor to provide all trenching and backfill for conduits. This includes DC wiring.
5. General Contractor to provide all grading, asphalt demolition, re-surfacing and asphalt patching.
6. General Contractor to provide form work for all parking structure piers.
7. General Contractor to provide all concrete work. This includes pads for inverters and also footings for parking structure supports. Provide all rebar.
8. General Contractor to provide all steel and erection services for parking covers.
9. General Contractor to secure solar PV panels (furnished by Trane) to parking covers.
10. Division 16 DC Electrician to provide and install all DC side conduit, wire, fittings and connections from the Inverter out to the Solar Panels. Trane to provide all material as called out on the Plans. Sawcut, excavation , demo of paving, haul off by GC.
11. Division 16 DC Electrician to assist in all start up of the Solar System. A 3rd Party Solar Engineer will be retained by Trane for this purpose.
12. Trane to provide for inspections.

6.9 Window Upgrades on Second Floor of City Hall

Double pane window retro-fits will be performed per plan callouts on the Second Floor of the City Hall Building. Window Subcontractor to provide this per drawings.

Appendix A - Existing Conditions

3.1 GENERAL INFORMATION

The City of Ridgecrest, California is located in the Mojave Desert 152 miles north of Los Angeles, CA near the intersections of US Highway 395 and State Route 14. It is home to approximately 40,000 people within the City limits and serves an additional 25,000 people in the greater area within the Indian Wells Valley. The primary local industry is the China Lake Naval Weapons Center, which is located immediately adjacent to the City.

The City is at 2200 feet in elevation. It is similar in climate to Las Vegas, Nevada. Published climate information for the City shows it to be rated for summer time 1% design-day condition of 106 degrees F dry bulb and 70 degrees F wet bulb and winter dry bulb temperature of 28 degrees F. It is located in seismic zone 4, due to its proximity to the San Andres fault.

3.2 CIVIC CENTER BUILDINGS

The main Civic Center complex is located at 100 West California Street and consists of City Hall and the Kerr-McGee Community Center buildings. Both buildings were constructed in 1989**.**

Figure 1- Ridgecrest Civic Center

The Civic Center Complex is on a single electric meter with power provided by Southern California Edison (SCE). The complex is on the Edison Time-Of-Use (TOU) GS-3B rate plan. All power is purchased from Edison. There is no separately sourced direct power purchasing agreement. A complete listing of all applicable SCE rate plans can be found in Appendix G. The City is not currently participating in any of the Edison rate reduction programs such as Automated Demand Response, Capacity Bidding Program or Demand Bidding Program.

The cumulative electrical energy usage at the Civic Center for the year 2007 on the main 3-001-1901-95 meter was 1,251,723 kWh of power consumed, with a peak demand of 388 kW. The cost of this service was $175,396. The average cost for power during this period was $0.14/kWh.

The power enters the property from the north side of the property line. The main switchgear and meter is located in the first floor electrical room of City Hall. There is an 80kW Onan emergency

generator in the utility enclosure located north of the building that is connected to a separate emergency power circuit and transfer switch (see Figure 2). There is no line filtering or power quality adjustment equipment in place. No preventative maintenance work on the switchgear has been done. There is currently no on-site power generation being done. It is not possible to obtain separate electrical usage amounts for each building with the current metering arrangement. Complete details of the all City Electrical Utility usage is shown in Appendix B.

Figure 2- Onan Emergency Generator

Gas service is provided by the Pacific Gas and Electric Company. There are separate meters for the Community Center and City Hall. The complex is on the GNR-1 rate plan. All gas is purchased from the Pacific Gas and Electric Company, instead of being separately sourced via a secondary purchasing agreement.

The cumulative gas usage for the year 2007 at the Civic Center on two main meters was 16,042 therms of gas consumed. The cost of this service was $20,152. The average cost for gas during this period was $1.26/therm. Complete details of the all City gas usage is shown in Appendix C

Total cost for these utilities in this location for calendar year 2007 was $195,548.

CITY HALL

Building Envelope Information

The City Hall building has 41,600 square feet of usable space and is two stories tall. The City Hall houses all City Administration functions and the Police Department. The City Council Chambers are also attached as a single story building wing. City Hall is shown in Figure 3.

Figure 3- Ridgecrest City Hall

The construction is primarily concrete-masonry units (CMU) with stucco overlay. There are large glass areas on the building that account for 30% of the external façade. There are shade covers/overhangs on the first floor windows on the south facing side only. There is no shading on any of the other windows on the second floor or atrium. There is a built up roof with 2" of insulation with a white reflective cover.

Building Glass

The glass areas of the building fall into two categories. There is shaded ¼" single pane "Storefront" glass with aluminum mullions along the building perimeters and in the office areas. This glass has tint but does not have a low Solar Heat Gain Coefficient (SHGC). Examples of this are shown in the pictures below.

Figure 4- “Storefront” Glass

The atrium has shaded ¼” plate glass held in place in the metal frames with rubber gaskets. The atrium glass is shown in Figure 5 below.

Figure 5- Atrium Glass

There are several problems with the glass that is in place right now.

- The existing tinted ¼” single pane atrium and storefront glass has a Solar Heat Gain Coefficient (SHGC) of about 0.65. This means that a very high amount of UV radiation and heat (in addition to the light) passes through the glass into the space. This causes occupant discomfort as well as increasing the cost of cooling the spaces. Double pane glass with a high quality coating has Solar Heat Gain Coefficient (SHGC) of about 0.25. Cooling requirements due to heat transfer through the glass could be reduced by more than half with new double pane glass.
- The Atrium glass zipper gasketing and caulking is in very poor condition. The caulking has large gaps in it that allow air and water to pass through. The metal frame work is discolored and has rust pockets present. There is water damage as the result of leaks on the interior surfaces. This includes paint discoloration to the structural steel beams and concrete and damage to the carpeting. The zipper gasketing is very brittle due to age and is at the end of its rated life.

Some of the defects in the atrium glass are shown in Figure 6 below.

Figure 6- Atrium Glass Caulking

It should be noted that there is a potential safety hazard present as the glass relies on the zipper gasketing for structural support. Due to the deteriorated and brittle condition of the gasketing, if winds exceed 65 mph, there is a potential that the glass could fall out of the framework.

Building Mechanical Systems Information

City Hall has all of the mechanical equipment located on the roof of the building. Cooling is done with eight DX package unit systems. Half of these units were installed in 1989 as part of the original construction. Two were added in 2003 and three were replaced with new units in 2005.

Figure 7- Unit AC-1

Figure 8- Unit AC-2

Figure 9- Unit AC-3

Figure 10- AC Units 1, 2 and 3

Figure 11- Unit AC-4

Figure 12- Unit AC-5

Figure 13- Unit AC-6 Figure 14- Unit AC-7

Figure 15- Unit AC-8

There are also three newer small split system units that serve data centers that were added after the building was erected. These are shown in Figures 16, 17 and 18.

Figure 16- Unit CU-1 Figure 17- Unit CU-2 Figure 18- Unit CU-3

AC Units 2, 3, 4 and 5 have full economizer capability, none of which are currently functional. AC units 1, 7 and 8 have fixed position outside air dampers. The split systems have no outside air make up capabilities. A summary of the Cooling Mechanical Systems is shown in Table 1.

Mark	Make	Model Number	Installed	Serves	Located	Air Flow (CFM)	Static Pressure (inches w.c.)	Cooling Capacity (Tons)	Heating Capacity (BTU's per Hour)	Fan Power (HP)
AC-1	York	D2 CG036 NH146B	1989	Council Conference Room	1st Floor Roof	1200	1.0	3	42,000	0.5
AC-2	York	D1 SS180 G26546 EPB	1989	Council Chambers	1st Floor Roof	5000	2.0	15	200,000	5
AC-3	York	D1 SU 360 A46 MLB	1989	First Floor Office	1st Floor Roof	12000	2.3	30		15
AC-4	Carrier	50HG 028AG 611AG	2005	First Floor Police	2nd Floor Roof	10000	2.0	25		10
AC-5	Carrier	50HG 028AG 611AG	2005	Second Floor	2nd Floor Roof	12000	2.3	30		15
AC-6	Carrier	48HJD017 691QA	2002	Atrium	2nd Floor Roof	8000	1.5	20	200,000	7.5
AC-7	Carrier	48TFL005A611	2002	Second Floor NW offices	2nd Floor Roof	2000	1.0	4		0.75
AC-8	Carrier	48TFL005A611	2002	Second Floor South Offices	2nd Floor Roof	2000	1.0	4		0.75
CU/FCU-1	Carrier	24ACR360A310	2005	First Floor Data Room	2nd Floor Roof	900	1.0	3		0.25
CU/FCU-2	Carrier	24ACR324A300	2005	Second Floor South Data Room	2nd Floor Roof	750	1.0	2.5		0.25
CU/FCU-3	Soleus	KFR-12W	2005	Second Floor Telephone Room	2nd Floor Roof	150	1.0	0.5		0.25
				Totals		54000		136.5	442,000	55.25

Table 1- Ridgecrest City Hall HVAC Cooling Equipment

An important item to note regarding the rated tonnage of the mechanical equipment is that the 136 tons of cooling capacity in place at City Hall is based on the ARI rating of the equipment when it was new. The ARI tonnage rating is based on having an outside air temperature of 95 degrees F. If the outdoor air temperature exceeds 95 degrees F, which is oftentimes the case in Ridgecrest, especially on the roof of the building where heat being rejected from the package units is trapped behind the parapet walls, the cooling capacity of the DX package units is significantly decreased. At an outdoor air temperature of 125 degrees F, the cooling capacity can be reduced by as much as 30%. Larger de-rates will occur if the units are not properly maintained, i.e. improper refrigerant charges due to leakage, bent or collapsed fins on the condenser coils, slipping fan belts on the condenser fan motors, etc..

It should also be noted that some of the original package units that were installed in 1989 are still in place. The ASHRAE standard life cycle for package units is fifteen years, upon which time replacement is recommended, as maintenance and operational costs will usually exceed the depreciated cost of the asset. Harsher environments will reduce life expectancies by an additional 30%. These units are well past the rated 15 year life and will be due for replacement in the near term future. The age of these units also suggests that additional exceptional maintenance costs can be anticipated in the near term future in the form of compressor rebuilds and miscellaneous unit failures (condenser fan motors, refrigerant leakage etc.) if replacements are not made. During these occurrences, occupant comfort issues will also arise.

These units are also no longer energy efficient due to the original construction design, wear of component parts and oxidation on heat exchange surfaces. The average EER rating of the units now in place is approximately 8.0. New package units typically average an EER rating of about 12.

Heating is done primarily by three separate gas fired furnaces that serve the main building complex. These units are ducted into the return air system for the building and use constant volume fans for air delivery. The Council Chambers are heated by gas fired furnaces located in the package units. The gas fired furnaces are shown in Figures 19, 20 and 21.

Figure 19- Unit RF-1 Figure 20- Unit RF-2 Figure 21- Unit RF-3

A summary of the Mechanical Heating Systems is shown in Table 2.

Mark	Model	Model Number	Installed	Serves	Located	Air Flow (CFM)	Static Pressure (inches w.c.)	Heating Capacity (BTU's per Hour)	Fan HP
RF-1	Modine	RT350BORS	1989	First Floor West	1st Floor Roof	4390	1.0	280,000	2
RF-2	Modine	RT200BORS	1989	First Floor South	2nd Floor Roof	2955	1.0	160,000	2
RF-3	Modine	RT400BORS	1989	Second Floor	2nd Floor Roof	5960	1.0	320,000	3
				Totals		13,305		740,000	7

Table 2- Ridgecrest City Hall HVAC Heating Equipment

There are also eleven (11) exhaust fans located on the building roof. These serve for general building exhaust (EF) and also as toilet exhaust (TXF). A summary of the Exhaust Fans is shown in Table 3.

City Hall							
Mark	Model Number	Serves	Located	Air Flow (CFM)	Static Pressure (inches w.c.)	Fan Power (HP)	Remarks
EF-1	VEDB06B2	Council Conference Room	1st Floor Roof	250	0.25	0.1	
EF-2	VCDB010	Council Conference Restroom	1st Floor Roof	90	0.25	0.1	
EF-3	VEBC15K2	Restrooms	1st Floor Roof	800	0.25	0.15	
EF-4	VECB06B2	Restrooms	2nd Floor Roof	210	0.25	0.1	
EF-5	VEBC18	Restrooms	2nd Floor Roof	1160	0.25	0.5	
EF-6	VEDB08E2	Restrooms	2nd Floor Roof	270	0.25	0.1	
EF-7	VEDB08E3	PD Conference Room	2nd Floor Roof	450	0.25	0.1	
EF-8	VEDB06B2	Conference Room	2nd Floor Roof	250	0.25	0.1	
EF-9	VEDB08E2	Restrooms	2nd Floor Roof	600	0.25	0.1	
EF-10	VEDB06B2	Restrooms	2nd Floor Roof	250	0.25	0.1	
EF-11	VEDB06B2	Kitchen	2nd Floor Roof	250	0.25	0.1	
		Totals		4580		1.55	

Table 3- Ridgecrest City Hall Exhaust Fans

AC Units 1, 2, 6, 7 and 8 and also all the split system fan coil units have constant volume fans that run continuously as long as the units are enabled. These systems serve single zones.

AC Units 3, 4 and 5 are ducted into individual cold ducts that serve different areas of the building. Furnaces RF-1, 2 and 3 are ducted into hot ducts that run parallel to the cold ducts. Individual zone control is done using double duct variable air volume (VAV) boxes. These are pressure independent boxes with independent hot and cold duct damper control. Only the cold deck has air flow sensing. There is a common supply air temperature sensor in the common discharge duct. A schematic of how this system works is shown in Figure 22.

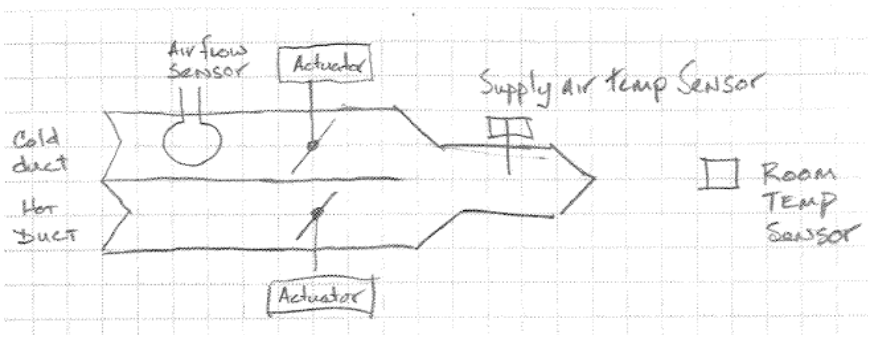

Figure 22- Double Duct Variable Air Volume Control Schematic

Some of the zones are cooling only VAV boxes. These are configured as shown in Figure 23.

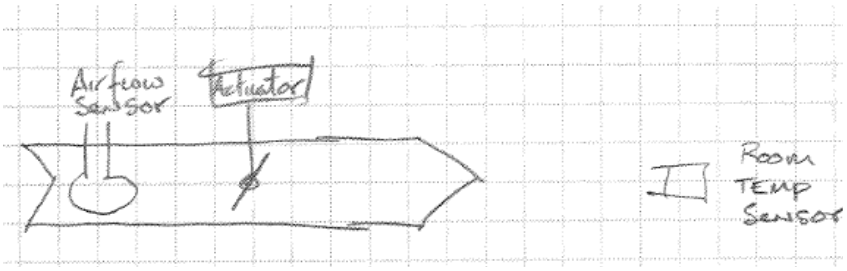

Figure 23- Cooling Only Variable Air Volume Control Schematic

There are a total 32 VAV zones located in City Hall. Table 4 lists each of these boxes, original air flow requirements, and areas served.

		City Hall					
		Cooling		Heating			
Mark	Size (Inches)	Air Flow (CFM)	Inlet Size (Inches)	Air Flow (CFM)	Inlet Size (Inches)	Minimum Air Flow (CFM)	Area Served
VAV-1	7	530	7	400	6	400	Council Lobby
VAV-2	16	2400	16	1200	12	1200	Building Department Lobby
VAV-3	12	1200	12	900	8	900	Clerks Work Area
VAV-4	6	400	6	300	5	300	Conference Room
VAV-5	6	430	6	300	5	300	Plan Room and Storage
VAV-6	12	1200	12				Electrical Room
VAV-7	14	1500	14				Elevator Room
VAV-8	5	355	5	285	5	285	Building Inspector and Planner
VAV-9	7	590	7	450	6	450	CD Staff Area
VAV-10	7	510	7	250	5	250	CED Director
VAV-11	10	900	10	450	7	450	Public Works Director
VAV-12	7	700	7				Copy room
VAV-13	12	1350	12	1000	10	1000	Engineering

VAV-14	7	650	7	490	6	490	Police Lobby
VAV-15	10	850	10	425	7	425	Records and Communications Supervisor
VAV-16	7	664	7	330	5	330	Records and Administrative Lieutenant
VAV-17	10	839	10	420	7	420	Captains Office
VAV-18	12	973	12	485	8	485	Police Department Conference Room
VAV-19	12	1078	12	540	8	540	Detective Room
VAV-20	14	1700	14				Watch Commander
VAV-21	14	1440	14				Training and Interview
VAV-22	7	692	7				Training and Storage
VAV-23	5	400	5	300	5	300	Police Back Hallway
VAV-24	8	730	8				Shower and Locker
VAV-25	7	600	7	400	6	400	Evidence Locker
VAV-26	6	385	6	289	5	289	City Administration
VAV-27	8	680	8	510	7	510	Storage
VAV-28	8	720	8	360	6	360	Administration
VAV-29	7	466	7	233	5	233	Council Office
VAV-30	6	385	6	289	5	289	
VAV-31	10	800	10	600	7	600	City Clerk
VAV-32	8	670	8	502	7	502	City Clerk Staff
		26787		11708		11708	

Table 4- City Hall VAV Boxes

There are several important items to note regarding the VAV zone controls in City Hall.

1. There is a Johnson Controls MetaSys DDC System, Version 5.4, controlling the VAV boxes and Package Units. The new control was installed the existing VAV boxes as part of the last energy retrofit project in 2002. This is a modern DDC system that is still fully functional.
2. The VAV boxes and controls are designed as variable volume systems, i.e. as the room temperature moves away from set point, the damper actuator to modulate between maximum and minimum settings. Only the cold deck responds directly to air flow readings.
3. VAV boxes require a steady air pressure of approximately 1.0” w.c. of static pressure at each box inlet in order to operate properly.
4. The supply fans serving both the hot and cold ducts right now are all single speed constant volume fans.
5. In order to maintain a constant zone pressure when the VAV box dampers modulate, variable air flow from the fans is required. The constant volume fans cannot deliver this.
6. Given the current lack of variable air volume control, stable temperature control in the spaces will be very difficult to achieve.
7. The VAV boxes and controls were probably never properly commissioned, given the inadequacies of the current mechanical system.
8. The City is paying significantly more for energy with a constant volume fan system than it should be i.e. with a variable volume air system.
9. Room temperature set points are approximately 72 degrees for cooling and 68 degrees for heating in the Administrative Areas and City Council areas, although these are adjusted for individual occupant comfort. The Police Department cooling set points are typically closer to 68 degrees F with the heating set point at 66 degrees F.
10. Occupancy Schedules for City Hall are per the following table:

Area	Occupied Days	Occupied hours
Council Chambers	M-Th	5PM-11PM
Administration	M-F and Tu-F	7:30AM-5:30PM
Police Department	All	All

Table 5- City Hall Occupancy Schedule

11. Currently, all the fans serving the spaces appear to be following the set schedules. There is a 1 hour morning warm-up ahead of Occupancy.
12. There are minimal night set-backs on the room temperature in place. This is due to concerns about loosing the building. This will lead to constant fan cycling at night.

There are several other important issues regarding air flows and air distribution in general at City Hall.

1. The existing duct work is close to 20 years old and has been modified extensively during this time period. Specifically, AC Units 7 and 8 and all three split systems were added since the original construction. In other areas, walls have been moved and spaces reconfigured without changes being made to the air distribution. No Certified Air Balance work was performed after these changes were made. This has caused system wide problems with the result being too little or too much air in some areas. No records of the 'as-built" duct work are available.
2. The occupancy patterns of the building have changed and large amounts of additional electronic equipment have been added since original construction and the last air balance was done. This has resulted in many "hot spots" in different areas.
3. People now occupy some areas that were originally intended as storage only. There is no air service at all in these areas. This is a violation of Title 24 air quality requirements, plus very uncomfortable for the occupants.
4. There is a high likelihood of duct air leakage above the drop ceilings as the result of age and uncontrolled modifications being made. This has would result in reduced air flows to some areas and also increased overall costs of heating and cooling the building due to excessive use of fan energy. Typically, duct air leakage and incorrect air distribution can increase HVAC operating costs by as much as 15%.
5. There is no return air ducting from the Police Department to the air handler units. This was the result of incomplete work during the last renovation.
6. It appears that there was never enough total air flow provided for in the original design as the result of incorrect engineering.

Building Lighting

Most of the interior lighting in the occupied areas of the building has been upgraded to high efficiency 32W T8 lamps or Compact Fluorescents (CF's). This was done several years ago during the previous energy retrofit work. There are some motion sensors in the spaces and there is no master lighting control panel in place. Shutting off lights during un-occupied hours is dependant on Staff to perform this function.

While there are large glass areas on the building and large amounts of daylight pass through to the occupied spaces, there are no controls in place for daytime dimmability. This results in over lighting occurring during daylight hours unless lights are manually shut off.

The exterior lighting on the building and the parking lot lights were partially upgraded during the previous retrofit work. The exterior building lighting still has incandescent lamps in many locations. The pole lamps in the parking lot are all HID metal halide.

The survey lighting results are shown in Appendix F.

Domestic Hot Water Usage

The building has a single 57,500 BTU/Hour 75 gallon domestic hot water heater fed by natural gas. This provides all hot water for the building. Gas usage by this heater is negligible.

Figure 24- City Hall Domestic Hot Water Heater

Building Design Information

According to the load profile of the building as calculated by the Trane Trace 700 building software simulation, with the maximum cooling coil load based on a 1% design-day and, the overall block load cooling requirement for City Hall is estimated to be 150 tons. The heating requirement is calculated to be 1,182,000 BTU's per Hour.

Based on the simulation, there is currently a 15 ton shortfall in cooling with an outdoor air temperature of 95 degrees F. If a 30% de-rate of the existing DX package units is factored in, the actual cooling short fall on a design day will be closer to 30 tons, or 15% of the current capacity, provided all existing mechanical equipment is in proper operating condition.

Design cooling air flows are calculated to be 60,000cfm. This means there is also a 4,500 cfm overall shortfall in total air based on the model.

Kerr-McGee Community Center

Building Envelope Information

The Kerr-McGee Community Center building has 40,300 square feet of usable space and is one story tall. The Community Center houses all Parks and Recreation Administration functions. It also has sports facilities consisting of basketball courts, handball courts, and a fitness center. There is also a child care area, meeting rooms and a kitchen facility in the building. The Community Center is shown in Figure 25.

Figure 25- Ridgecrest Community Center

The construction is primarily concrete-masonry units (CMU) with stucco overlay. There is some glass areas on the building that accounts for 15% of the external façade. There are shade covers/overhangs on the first floor windows on the north and west facing sides. The building has a white membrane roof with 2" of insulation.

Building Glass

The glass areas of the building are shaded ¼" single pane "storefront" glass with aluminum mullions along the building perimeters and in the office areas. Examples of the glass are shown in the pictures below.

Figure 26- SW Corner

Figure 27- NE Entrance

The existing single pane glass at the Community Center is the same glass that is installed at City Hall and has a same low Solar Heat Gain Coefficient (SHGC). The effect of the glass is less pronounced on the Community Center HVAC systems due to the higher percentage of overhang/shading and the lower overall percentage of glass in use.

Building Mechanical Systems Information

The Community Center has all of the HVAC mechanical equipment located on the roof of the building. Cooling is done with fifteen (15) DX package unit systems with gas fired heaters. Most of these units were installed in 1989 as part of the original construction. One of the original package units have been replaced with new. These units are shown in the pictures below.

Figure 28- Unit AC-7

Figure 29- Unit AC-8

Figure 30- Unit AC-9

Figure 31- AC Unit-10

Figure 32- Unit AC-11

Figure 33- Unit AC-12

Figure 34- Unit AC-13

Figure 35- Unit AC-14

Figure 36- Unit AC-15

Figure 37- Unit AC-16

Figure 38- Unit-17

Figure 39- Unit AC-18

Figure 40- Unit AC-19

Figure 41- Unit AC-20

Figure 42- Unit AC-21

AC Units 7-10 and 13-16 have full dry bulb economizer capability, none of which appear to be currently functional. The remainder of the units have fixed position outside air dampers. A summary of the Cooling Mechanical Systems is shown in Table 6.

Community Center										
Mark	Make	Model Number	Installed	Serves	Located	Air Flow (CFM)	Static Pressure (inches w.c.)	Cooling Capacity (Tons)	Heating Capacity (BTU's per Hour)	Fan Power (HP)
AC-7	York	D1SC300G400	1989	Gym/Storage	1st Floor Roof	10000	1.00	25	308,000	7.5
AC-8	York	D1SS2440G265	1989	Gym	1st Floor Roof	8800	0.75	12	200,000	7.5
AC-9	York	D1SS2440G265	1989	Multipurpose Room	1st Floor Roof	8800	0.75	12	200,000	7.5
AC-10	York	D1SS2440G265	1989	Multipurpose Room	1st Floor Roof	8800	0.75	12	200,000	7.5
AC-11	York	D1CG090N130	1989	Art/Craft	1st Floor Roof	3000	1.00	7.5	129,000	2
AC-12	York	D1CG060N082	1989	Daycare	1st Floor Roof	2500	0.75	5	82,000	1
AC-13	York	D1CG150N165	1989	Aerobics	1st Floor Roof	5000	1.00	12.5	150,000	3
AC-14	York	D1CG150N165	1989	Racquetball	1st Floor Roof	4500	1.00	12.5	161,000	3
AC-15	York	D1CG048062	1989	NE Lobby	1st Floor Roof	1600	0.75	4	62,000	0.75
AC-16	York	D1CG150N165	1989	Kiitchen	1st Floor Roof	4500	2.00	12.5	161,000	3
AC-17	York	D1CG060N082	1989	Meeting Rooms	1st Floor Roof	2000	0.75	5	82,000	1
AC-18	York	D1CG060N082	1989	Meeting Rooms	1st Floor Roof	2000	0.75	5	82,000	1
AC-19	York	D1CG060N082	1989	Meeting Rooms	1st Floor Roof	2000	0.75	5	82,000	1
AC-20	York	D1CG060N082	1989	Storage,Corridor	1st Floor Roof	2000	0.75	5	82,000	1
AC-21	York	D1CG048062	1989	Lobby	1st Floor Roof	1600	0.75	4	62,000	0.75
				Totals		67100		139	2,043,000	47.5

Table 6- Ridgecrest Community Center HVAC Equipment

The rated cooling capacity of the mechanical equipment at the Community Center 139 tons at 95 degrees F outside air temperature. This equipment is subject to the same de-rates in the cooling capacity as at City Hall (by as much as 30%) based on elevated outside air temperatures. The rated heating capacity of the units is 2,043,000 BTU's/Hour.

The efficiency of these package units is also relatively low. The Energy Efficiency Rating (EER) of these units averages approximately 8.0, which was typical of units manufactured in 1989. Units manufactured in 2007 are required to have an EER rating of at least 12 in order to meet minimum efficiency standards. EER is defined as the BTU's of cooling capacity divided by the power drawn by the unit, in Watts.

It should also be noted that most of these are original units that were installed in 1989, and are well past the rated 15 year life of package units. These units will be due for replacement in the near term future.

The Community Center also has a Kitchen in the building. The kitchen hood is served by a make-Up air fan with and evaporative pre-cooler and exhaust fan. A picture of these units and a mechanical summary of the Kitchen Hood System are shown below.

Figure 43 - Kitchen Hood Make-Up Air and Exhaust Fan

There are also eleven (11) exhaust fans located on the building roof. These serve for general building exhaust (EF) and also as toilet exhaust (TXF). A summary of the Exhaust Fans is shown in Table 7.

Community Center							
Mark	Model Number	Serves	Located	Air Flow (CFM)	Static Pressure (inches w.c.)	Fan Power (HP)	Remarks
EF-12	VEDC18L4	Restrooms	1st Floor Roof	450	0.25	0.25	
EF-13	VEDB08E2	Restrooms	1st Floor Roof	225	0.25	0.1	
EF-14	VEDB06E2	Restrooms	1st Floor Roof	450	0.25	0.1	
EF-15	VEDB08E2	Restrooms	1st Floor Roof	700	0.25	0.1	
EF-16	VEDB10E2	Restrooms	1st Floor Roof	1600	0.25	0.1	
EF-17a	VEDC18L4	Restrooms	1st Floor Roof	1600	0.25	0.25	
EF-17b	VEDC18L4	Restrooms	1st Floor Roof	1600	0.25	0.25	
EF-18	VEDC18L4	Restrooms	1st Floor Roof	1600	0.25	0.25	
EF-19	VEDC18L4	General	1st Floor Roof	2000	0.25	0.25	
EF-20	VEDB08E2	Restrooms	1st Floor Roof	240	0.25	0.1	
EF-21	VUBB-24	Kitchen	1st Floor Roof	6000	0.35	2	

Totals	16465	3.75

Table 7- Ridgecrest Community Center Exhaust Fans

Unlike City Hall, the Package Units provide conditioned air to single zones All the package units have constant volume fans. A schematic of how a typical package unit system works is shown in Figure 44. .

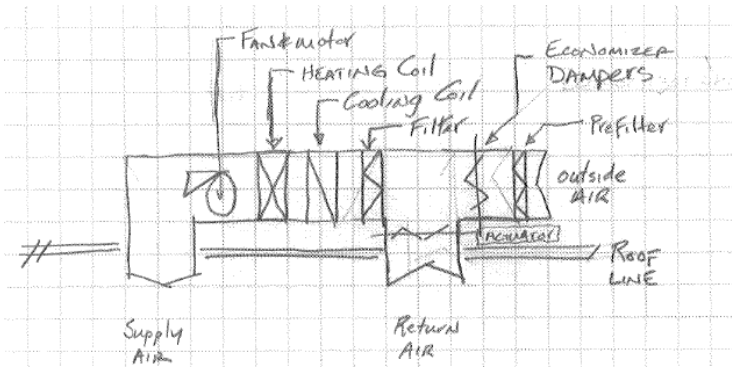

Figure 44 - Package Unit System

There are several important items to note regarding the package unit controls in the Community Center:

1. The Johnson Controls MetaSys DDC System that was installed as part of the last energy retrofit project five years ago has been replaced recently with stand-alone electric thermostats.
2. Room temperature set points are approximately 72 degrees for cooling and 68 degrees for heating in the Administrative Areas.
3. The run hour schedule for the package units is unknown at this time. It appears that many of the units are running when areas are unoccupied.

There are several other important issues regarding air flows and air distribution in general at the Community Center

1. The existing duct work is close to 20 years old and has been modified. The modifications made at the Community Center have not been as extensive during this time period as at City Hall. The Community Center on average (unless there is a special event) does not have a high occupant density, so problems with air flow are less noticeable.
2. No Certified Air Balance work was performed after air distribution changes were made. No records of the 'as-built" duct work are available.
3. There is now some occupancy of areas that were originally intended as storage only. There is no air service at all in these areas. This is a violation of Title 24 air quality requirements, plus very uncomfortable for the occupants.
4. There is a likelihood of duct air leakage above the ceilings as the result of age and uncontrolled modifications being made. This appears to be less prevalent than at City Hall.
5. It appears that there was never enough total air flow provided for in the original design as the result of incorrect engineering.

Building Lighting

Most of the interior lighting in the occupied areas of the building has been upgraded to high efficiency 32W T8 lamps or Compact Fluorescents (CF's). This was done several years ago during the previous energy retrofit work. The gymnasium still has the original metal halide lamps

in place. There are no motion sensors in the spaces and there is no master lighting control panel in place. Shutting off lights during un-occupied hours is dependant on Staff to perform this function.

While there are areas in the building where large amounts of daylight pass through to the occupied spaces, but there are no controls in place for daytime dimmability. This results in over lighting occurring during daylight hours.

The exterior lighting on the building and the parking lot lights were not upgraded during the previous retrofit work. The exterior building lighting still has incandescent lamps in many locations. The pole lamps in the parking lot are all HID metal halide.

The survey lighting results are shown in Appendix F.

Domestic Hot Water Usage

The building has a single 570,000 BTU/Hour hot water boiler fed by natural gas. The system has a 500 gallon storage tank with a re-circulating pump. The hot water is supplied to the building using a re-circulating system and secondary pump. This provides all hot water for the building. Gas usage by this heater is negligible.

Figure 45 - Community Center Domestic Hot Water System

Building Design Information

According to the load profile of the building as calculated by the Trane Trace 700 building software simulation, with the maximum cooling coil load based on a 1% design-day and an 80% diversity factor, the overall block load cooling requirement for Community Center is estimated to be 150 tons. The heating requirement is calculated to be 2,020,000 BTU's per Hour.

Based on the simulation, there is an 11 ton shortfall in cooling with an outdoor air temperature of 95 degrees F. If a 30% de-rate of the existing DX package units is factored in, the actual cooling short fall on a design day will be closer to 25 tons, or 15% of the current capacity, provided all existing mechanical equipment is in proper operating condition.

Design cooling air flows are calculated to be 67,100 cfm.