# Orcas Island Health Clinic

## Heating, Ventilating, and Air Conditioning System Review and Recommendations Report

**7 Deye Lane**
**Eastsound, WA 98245**

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## TABLE OF CONTENTS

# 1. INTRODUCTION

## 1.1 EXECUTIVE SUMMARY

Hargis Engineers, Inc. (Hargis) was retained by the Orcas Island Health Care District (OIHCD) to review the current conditions within the existing Orcas Island Health Clinic located at 7 Deye Lane in Eastsound, WA. Hargis visited the site on June 5th, 2019 to meet with the OIHCD building committee, Clinic Office Manager, and the local power utility. The general topics for discussion were: proposed mechanical system replacement, proposed reroofing project, construction coordination, clinic operation and complaints, building energy usage, and utility rebate feasibility. There was also a walk-through of site, occupied spaces of the building, and the attic.

In discussions with the OIHCD building committee, the main objectives of the renovations are: the proper operation of the mechanical system for comfort, reroofing the building to include either providing a pressure barrier at the ceiling or revising the insulation to create an unvented attic, and coordinating any mechanical work with the roof replacement work. The clinic will need to remain open during the renovations.

The HVAC equipment and ductwork in general appears to be in poor condition. This is due to the age of the system being 28 years which exceeds its service life. Another issue is the indoor equipment is difficult to access for maintenance. A summary is provided in Section 2.5 of this report of existing HVAC system deficiencies based on a review of maintenance records, as-built drawings, and observations made during the walk-through. Remediation strategies are provided.

An energy study for the building was done by a 3rd party firm in March 2019 and concluded that the aged HVAC system and lighting are the main opportunities to improve the building energy performance and also recommended adding a solar collector system. The report estimated an annual savings of $1,475 if the existing ducted heat pumps and thermostats are replaced with ductless heat pumps, which is about a 12.8% savings compared to the 2018 annual energy consumption. In reviewing the building electricity data, the usage per year was trending down from the high in 2013 to a low in 2015/2016, but trended back up to a new high in 2018. The demand usage fluctuated from year to year but is trending up to a new high in 2018 as well. Most of the electricity is used in the winter months, likely due to the lack of pressure barrier at the roof and supplemental electric heaters engaging instead of using the heat pump compressors. There is likely poor control between heat pump heating and supplemental electric heating. This less efficient heating method could be contributing to the high electricity demand charges seen in the utility data.

Hargis reviewed the HVAC renovation proposals provided by two contractors in 2017. There is no way to adequately compare them because they are not based on the same type of HVAC system nor are they structured the same. Also the proposals are out of date and need to be updated. Between the two HVAC proposals, the Sage Building Solutions proposal is closest to the total building solution that is expected, but there are many aspects that need refining. The recommended approach for the upcoming project is to prepare a formal Request for Proposal (RFP) that lists requirements for the design and construction that adheres to the OIHCD's requirements for HVAC, roofing, and how the two projects are tied together as one.

Regarding the roof and attic, it was determined that there are three issues with the current installation:

- There is no pressure barrier provided for the attic. Since the attic is vented the roof is not a pressure barrier and neither is the lay-in ceiling. Because of this the air exchanges freely between the unconditioned attic and the conditioned space, this is called infiltration. This results in heat, moisture, and particle transfer between the attic and occupied spaces that counteracts the performance of insulation and HVAC systems.
- Areas where the insulation is disturbed or missing short circuits the thermal barrier and allows unwanted heat loss and heat gain.

- The indoor HVAC equipment is located in the unconditioned attic which is allowed but not considered ideal. The large seasonal temperature fluctuations in the attic require additional insulation wrap for the ducts and AH units (per the energy code) and exposure to these temperatures can shorten the equipment life. Also, if the ducts are not sealed properly the infiltration issues outlined above will be increased. Based on observations the ducts do not appear to be adequately sealed.

These issues greatly impact building energy consumption and occupant comfort and should be addressed during the reroofing project. There are two general approaches that can be taken: convert the existing vented attic to an unvented attic, or keep as a vented attic and provide the proper pressure barrier. Insulation configuration options are provided in Section 5.2 of this report. Based on available information for the building, the options appear to be feasible. In comparing the benefits and drawbacks of each it is recommend to convert the existing vented attic to an unvented attic by installing R-38 insulation entirely above the roof deck, provided the existing roof structure can support the added weight of the insulation. By locating the insulation at the roof the attic becomes conditioned space, warmed by the air rising from below and providing an improved environment for the HVAC equipment.

The construction delivery method that is recommended for this project is to provide an RFP containing the entire project scope for open bid by general contractors, the goal being to obtain at least 3 competitive bids. In addition, there are some other design and construction support services that should be considered for this project. These services can assist the OIHCD in making sure the project has a successful outcome. Refer to Section 6.1.

The construction must be managed so that the impact of the work on the occupants is minimized. For this to occur, the HVAC portion of the work must coordinate with the reroofing portion of the work. Some combination of multiple strategies will need to be implemented to meet the goals. This will need to be detailed in the RFP document so the bidders are aware of these goals. There will be additional costs associated with these strategies for both the contractor and the Owner compared to having the building unoccupied during construction.

There was a meeting with representatives from Orcas Power & Light Co-op (OPALCO) to discuss potential rebates related to the renovations that can be used to help offset some of the renovation costs. OPALCO indicated incentives are available for the type of HVAC upgrades and insulation upgrades that are being considered for this facility. OPALCO provided context for the amount of rebates that are typically provided, with the average rebate being $2,400. A high end rebate is considered to be $20,000. Rebates are paid when the work is completed. Based on criteria provided at this meeting, it is estimated that $17,500 in rebates may be available for this project. Recommend rebates be pursued because the application process requires minimal effort.

## 1.2 OBJECTIVES

Hargis Engineers, Inc. (Hargis) was retained by the Orcas Island Health Care District (OIHCD) to review the current conditions within the existing Orcas Island Health Clinic located at 7 Deye Lane in Eastsound, WA. Hargis visited the site on June 5th, 2019 to meet with the OIHCD building committee, Clinic Office Manager, and the local power utility. The general topics for discussion were: proposed mechanical system replacement, proposed reroofing project, construction coordination, clinic operation and complaints, building energy usage, and utility rebate feasibility. There was also a walk-through of the site, occupied spaces of the building, and the attic.

The OIHCD building committee provided the following information to be reviewed by Hargis: building electricity consumption data, a building energy study provided by a 3rd party, relevant as-built drawings, maintenance records, and proposals for mechanical upgrades from two firms.

Hargis will provide recommendations for which proposals are likely to meet the OIHCD's performance and budget criteria, considering rebates, or indicate why none are appropriate. A budget for potential projects was not provided by the OIHCD building committee at this time. Also the proposals will be evaluated to determine how the mechanical and roof work can be coordinated and phased to limit clinic disruptions and minimize patient inconvenience. The clinic will need to remain open during the renovations.

In discussions with the OIHCD building committee, the main objectives of the renovations are: the proper operation of the mechanical system for comfort, reroofing the building to include either providing a pressure barrier at the ceiling or revising the insulation to create an unvented attic, and coordinating any mechanical work with the roof replacement work.

It was confirmed during the site meeting that the following items will not be reviewed or included in the scope of this report: plumbing, fire protection, lighting, lighting controls, solar collectors, windows, and building insulation except where the roof is discussed later in the report.

## 2. EXISTING CONDITIONS

### 2.1 TERMINOLOGY

- *Unsatisfactory Condition* - Equipment or service is showing signs of excessive wear when compared to its expected life span. Replacement is required.
- *Poor Condition* - Equipment or service is showing signs of excessive wear when compared to its expected life span. Major repairs are required.
- *Fair Condition* - Equipment or service is showing normal signs of wear consistent with its expected life span.
- *Good Condition* - Equipment or service is showing better than normal signs of wear when compared to its expected life span.
- *Service Life* - The median life expectancy for a system or piece of equipment with normal usage and maintenance according to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Equipment life expectancy can easily vary 5 to 10 years or more from ASHRAE depending on equipment exposure to the outdoor elements, usage, and maintenance.

### 2.2 BUILDING BACKGROUND

The Orcas Island Health Clinic is an existing facility located in Eastsound, WA. The 6,000 sf, single story building was constructed in 1991 with slab on grade and wood framing. The building is configured to have 4 wings emanating at 90 degree angles from a central octagonal rotunda. The South wing contains reception and waiting. The East wing contains walk-in care, procedure, and a training room. The North wing contains exam, medical storage, and a lab. The West wing contains office, exam, and a nurse area. The roof is hipped with a vented attic; refer to the reroofing discussion later in the report for more information. Many of the ceilings observed were a 2'x4' grid with lay-in ceiling panels. The electrical service for the building is a 208 volt / 3 phase service by Orcas Power & Light Co-op with an 800 amp bus located in the electrical room in the South wing. Building power is also served by a 10 kW propane generator located outside to the Northwest of the building. The generator has a manual switch that only serves electrical panel "E" (refrigerators, walk-in care, procedure, and reception). The building is equipped with a fire alarm system, but not equipped with an automatic fire sprinkler system. The site has extensive space and vegetation along the North portions of the building and the East and West ends of those respective wings. The South exposure of the building is paved for driveway and parking. The facility has been affiliated with UW Medicine since 2017. The facility is not credentialed through the Washington State Department of Health (DOH). Therefore a plan review process by DOH for the renovations is not anticipated. It is not believed that this facility has any other accreditations, clinic management to verify.

## 2.3 EXISTING HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEM

The HVAC for the building is currently provided by four indoor Air Handlers (AHs) located in the attic and four corresponding split Heat Pump condensing units (HPs) located at grade outside. The equipment was manufactured by Trane and is original to the building. The AHs in the attic are hung from structure with vibration isolation hangers. Each AH unit is comprised of a constant volume supply fan, direct expansion (DX) cooling/heating coil, supplemental electric heater, filters, and mixing box. Refrigerant piping is routed to connect the AH and HP units. A thermostat is provided for each AH and located in interior corridors or open space. The thermostats are not lockable and the controls are accessible by the occupants.

The following is a summary of the system service areas and capacities:

- AH-1/HP-1 serves the West wing – 5 tons of cooling, 59.5 MBH of heating, 27.06 kW supplemental electric heater, nominal 2,000 cfm of airflow.
- AH-2/HP-2 serves the South wing – 3 tons of cooling, 37 MBH of heating, 17.1 kW supplemental electric heater, nominal 1,200 cfm of airflow.
- AH-3/HP-3 serves the East wing – 4 tons of cooling, 46 MBH of heating, 17.1 kW supplemental electric heater, nominal 1,600 cfm of airflow.
- AH-4/HP-4 serves the North wing – 2.5 tons of cooling, 29.2 MBH of heating, 15.36 kW supplemental electric heater, nominal 1,000 cfm of airflow.

**Outdoor Heat Pumps (HPs)**


**Air Handler in Attic (AHs)**

The AH supply air ductwork is distributed via mains in the attics with branches to ceiling supply diffusers in each space. The main ductwork is composed of "ductboard" which is a compressed fiberglass material with a binder. The concern with this duct material is there can be glass fibers in the airstream and potential for mold growth over time. Return air to the AHs is ducted from single return grilles located in open spaces. AH-1 and AH-2 systems are served by return grilles in the central octagonal rotunda. Transfer grilles are provided in some rooms to transfer return air to the open spaces so the air can flow to the respective return grille, some rooms do not have this. This creates issues with return air pathways that can also impact supply airflow because the supply airflow becomes "deadheaded". Return airflow is especially difficult back to AH-2 because there is a door that prevents return airflow from reaching the rotunda grille when closed. Minimum ventilation air is ducted to the units from small intake grilles in the eaves with fire dampers and taps into the return ducts prior to entering the unit mixing boxes. The systems are not equipped with 100% outside air economizers which are required by current energy code.

**Ductboard Supply Air Main and Branch Ducts**

Flex duct is used in the industry for landing sheet metal ducts at the supply diffusers and return/transfer grilles. It is not meant to be a primary duct material and should be limited in use. The maximum flex duct length should be 5'-0". There are locations where the use of flex duct is excessive in length and is kinked in many areas which restricts airflow or is slipping off the diffuser/grille connection. Some flex did not appear to be connected at all. This condition is particularly concerning in the West wing where a flex duct was observed disconnected and packed with insulation. The duct insulation wrap observed on round branches are not an industry standard installation, using tape spiraled around and is coming apart in areas. Many ducts appear to be resting on the attic blanket insulation in many areas, all ducts need independent support and secured to building structure. The ducts need to be sealed tight to minimize leakage, observed the seals to be coming apart in areas.

Exhaust air is provided for toilet rooms, lab, staff room, and one of the storage rooms. There are 7 ceiling exhaust fans, one in each space ducted to exhaust grilles in the eaves with fire dampers.

The HVAC equipment and ductwork in general appears to be in poor condition. This is due to the age of the system being 28 years which exceeds its service life. See below for a recent service record summary that outlines failures due to age. Another issue is the indoor equipment is difficult to access for maintenance. The attic has a fair amount of head height, but it is difficult to access through the lay-in ceiling and there is not a platform to walk on in the attic, just bare joists so it's difficult to move around to service equipment and there is fall potential through the joists.

According to the maintenance records, the building was rebalanced by Barron Heating Air Conditioning in March 2018 with some unspecified duct modifications being done (likely adding balancing dampers at certain locations). A testing, adjusting, and balancing (TAB) report was not available at the time of this review. Without the TAB report it is not clear if the building is balanced for: proper heating/cooling airflows, proper minimum amount of ventilation airflow in each space, proper air changes for medical spaces, and if there are proper pressure relationships between certain spaces like toilet rooms.

## 2.4 HVAC MAINTENANCE RECORDS REVIEW

The HVAC service records from 2015 to 2018 were provided and reviewed. The service provider is Barron Heating Air Conditioning. The amount of service calls during this period is not unusual for equipment of this age and will only become more frequent as time passes without replacement. The following is a summary of the types of service during the period of recordkeeping:

- Filters were changed in February and April 2015, February and July 2016, May 2017, and May 2018. Recommend changing the filters twice a year, not sure why this changed to once a year in 2017. The record indicates the filters were found plugged and impacting airflow in May 2018 due to only changing once a year.
- Replaced a condenser motor, a capacitor, and contactors in June 2015.
- Repaired a water leak from one of the AHs in July 2016. This is likely a condensate pipe leak.
- Replaced a condenser motor, 3 capacitors, and a reversing valve in August 2016.
- Replaced faulty AH wiring in December 2016.
- Replaced AH blower motor in December 2016.
- Replaced AH fuse and reversing valve in June 2017.
- Replaced AH blower motor in June 2018.

Sometimes the repairs occurred 1 to 1.5 months after the issue was diagnosed at a scheduled maintenance visit or emergency call. The likely reason for this is the service provider does not have parts in stock to make the repairs immediately. This delay can be difficult for the occupants as the spaces will become too hot or cold while the equipment is down waiting for repairs. All of the repairs noted above occurred either in the winter or summer when the impact on the occupants is greatest. A new HVAC system that requires less maintenance will help avoid these scenarios.

## 2.5 COMFORT COMPLAINTS AND HVAC DEFICIENCIES

Based on a discussion with the Clinic Office Manager, the following are known comfort complaints that have occurred in the building at some point:

- There are spaces in the building that become too hot and/or too cold at times. Some specific feedback is the West corridor is too warm and the Lobby is too cold.
- It is believed that hot and cold areas are a result of only having 4 systems and thermostats. An area controlled by a thermostat is called a “zone”. There should be distinct zones for spaces on the perimeter vs. spaces on the interior, spaces with different perimeter exposures (West vs. North for example), and spaces that have different occupancies and uses. The systems are controlled based on the reading from its corresponding thermostat, so rooms served by a system that has different exposures and/or occupancy compared to the room that contains the thermostat, then there will be comfort issues.
- There are fire damper failures that block airflow causing overheating in some of the rooms.
- Some areas are described as “stuffy” at times. This is usually the result of poor return air pathways and the supply air “deadheading” as described above.
- Reports of thermostat settings being changed for both temperature and schedule. Need to be at standard settings for all.

- Reports of noise generated by diffusers and grilles.
- There are no indications of complaints about the building conditions causing illnesses.

The following is a summary of existing HVAC system deficiencies based on the walk-through and review of as-built drawings and some proposed remediation:

- Increase the number of HVAC zones from the current 4 thermostat locations in order to increase comfort control.
- Improve the return air pathways back to each unit. Each room should have a ducted return to the unit, except spaces that are exhausted.
- Replace all ductboard with galvanized sheet metal ductwork, properly seal, and support from structure. Repair the duct routing in the West wing and limit flex duct.
- Repair duct insulation.
- Locate the TAB report to verify the work that was done in 2018.
- Fix the noisy diffusers and grilles. Either replace with larger diffusers or rebalance to proper airflows.
- Provide airside economizers for the system or provide new system that has a code exception.
- Provide exhaust where rooms have been converted to different uses requiring exhaust by code: janitor room, shower room, and dirty utility room.
- The existing IDF room is only served by a supply diffuser with no temperature control. Recommend adding a dedicated mini-split heat pump system to serve this room.
- Thermostat controls should limit the electric supplemental heat use to when the outdoor temperature is below 40F. This will save energy.
- Adjust the temperature setpoints and occupancy schedule on the thermostats to standard settings. Provide lock boxes only accessible by clinic management.

## 3. BUILDING ENERGY USAGE

### 3.1 ENERGY STUDY REVIEW

An energy study for the building was done by Sustainable Connections a Bellingham, WA firm and report provided on 3/26/2019. The main conclusions of the report are that the aged HVAC system and lighting are the main opportunities to improve the building energy performance and also recommended adding a solar collector system. No detailed cost and payback analysis was done, only estimates. The report outlines 10 energy efficiency and water saving measures. The three measures that pertain to this report are measure #2 to upgrade the thermostats, measure #8 to replace ducted heat pumps with ductless heat pumps, and measure #9 to insulate and weatherize the building envelope. The estimated savings from items #2 and #8 is $1,475 per year which is about a 12.8% savings compared to the 2018 annual energy consumption which is reasonable. This is estimated and not based on an analysis. Note that most of the 80% annual energy savings indicated for implementing all the measures is due to adding the solar system.

The annual energy use for 2018 is 91,840 kWh for an annual cost of $11,500. The building uses electricity only and not propane. Most of the electricity is used in the winter months, likely due to the lack of pressure barrier at the roof and supplemental electric heaters engaging instead of using the heat pump compressors. There is likely poor control between heat pump heating and supplemental electric heating. This less efficient heating method could be contributing to the high electricity demand charges seen in the utility data.

The report concluded the building's energy use intensity (EUI) is 52 kBtu/sf/year currently. According to Energy Star data from 2018 the median site EUI for a medical office building in the U.S. is 51.2 kBtu/sf/year. This means that half of buildings of this type use more energy and half use less on a square foot basis. Because of the mild climate on Orcas Island it is reasonable to expect this number to be reduced with system upgrades.

The report documented that the thermostats are antiquated with limited functionality and seemed to be set to the wrong occupancy schedules and setpoints with no night setback or morning warm up. This contributes to energy and comfort problems. New thermostats meet the current code for functionality in order to save energy.

The report documented the existing heat pump system being at the end of service life and not efficient compared to newer systems. Two choices are presented which are to replace with a similar heat pump system but upgrade to a variable air volume (VAV) system with building controls, or provide a variable refrigerant flow (VRF) system with heat recovery.

The report discusses the attic insulation issue. The pressure barrier is at the roof plane and the thermal barrier is above the leaky lay-in ceiling. The suggestion is to contact a contractor to fix this.

### 3.2 ELECTRICITY CONSUMPTION AND DEMAND DATA

Data was provided for the building electricity usage in kWh consumption, electricity demand, and electricity cost for each year of complete data from 2013 to 2018. The electricity usage per year was trending down from the high in 2013 to a low in 2015/2016, but trended back up to a new high in 2018. The demand usage fluctuated from year to year but is trending up to a new high in 2018 as well.

The demand charges in 2018 have doubled compared to what they were in 2013. The increase was first seen in 2015 and has stayed high since then. Reducing demand charges is a priority in addition to reducing the annual kWh consumption. An example of the impact of electrical demand on the cost is that 7.2% more electricity was used in 2018 compared to 2013 (91,840 kWh vs. 85,680 kWh) but the cost was 40.8% higher ($10,773 vs. $7,650). While part of this is the increase in electricity consumption costs, a significant amount is due to demand increases. A new HVAC system such as a VRF system does not have electric supplemental heat so implementing this type of system would go a long way to solving the demand problem.

## 4. HVAC PROPOSALS

Hargis reviewed the HVAC proposals provided by two contractors. The proposals are not based on the same type of HVAC system nor are they structured the same so they are not comparable. Of the two, the Sage proposal makes more sense, but there are still issues with it as outlined below.

### 4.1 BARRON HEATING AIR CONDITIONING

A proposal was provided by Barron Heating Air Conditioning located in Ferndale, WA and dated December 7, 2017. This is the same firm that provides HVAC service for the building. This proposal is out of date and will need to be updated.

The proposal is to provide new Daikin single zone ductless mini-split systems with wall mounted indoor fan coil units. They have structured the pricing in a menu format with unit pricing for specific small systems as follows:

- Rooms up to 300sf – provide 0.75 ton ductless split system heat pump.
- Rooms up to 400 sf – provide 1.2 ton ductless split system heat pump.
- Rooms up to 700-800 sf – provide 2 ton ductless split system heat pump.

Some optional pricing is provided for higher efficiency units. Sizing HVAC equipment based on square footage of space served is not a recommended method. Load calculations need to be done for equipment sizing.

The proposal does not mention modifying or removing the existing system or how it will be controlled, coordinated with the existing system. There will be issues with two systems fighting each other and simultaneous heating and cooling which impacts comfort and energy. Electrical work is not included. Don't see this approach as a whole building solution, many outdoor units to service compared to a VRF system that has one outdoor unit.

Unit pricing is provided for each system which makes sense if only one is done, but would expect a discount if more units are installed. There is no statement about if prevailing wages are paid.

The payment terms indicates a 50% down payment with remainder due at completion. In commercial construction payment is typically based on progress of the work. Do not recommend a down payment for work not done.

## 4.2 SAGE BUILDING SOLUTIONS

A proposal was provided by Sage Building Solutions located on Lopez Island, WA and dated July 27, 2017. This proposal is out of date and will need to be updated. The proposal discusses deficiencies in the attic insulation and pressure boundary. The proposal recommends replacing the missing insulation or removing and locating at the roof with a pressure barrier, but a cost is not provided for this work and indicates they can provide if requested.

The proposal indicates that the current HVAC system is failing and that a new system will operate more efficiently and the energy savings will help offset the construction cost. Proposal notes the use of ductboard and outlines the drawbacks and recommends replacement of the ductboard. Diffusers and grilles that are properly designed can remain. The proposal points out the current poor ventilation system and recommends two new heat recovery ventilation (HRV) units with 70% efficiency to provide tempered ventilation in a pressure-neutral manner.

The scope of work outlined in the proposal is to provide a new HVAC system for the building. The system is a VRF system that provides heating and cooling paired with an HRV that provides minimum code required ventilation. The proposal indicates 3 options for the VRF system. For a building of this size the energy code requires a minimum efficiency of 3.2 COP, therefore only option 1 is feasible.

1. Mitsubishi City Multi - Efficiency = 3.6 COP
2. Daikin Commercial VRV – Efficiency = 3.0 COP
3. Daikin Large Residential VRF – Efficiency = 2.7 COP

The proposal also includes removal of the existing HVAC, assumes 9 temperature zones will be provided served by ducted fan coil units located in the attic, provides a new central heat pump outside, and new refrigerant lines. New thermostats for each zone will be provided with packaged controls that are viewed and adjusted from an online computer interface.

Hargis agrees that the current equipment is at the end of their useful life and the ductboard needs to be fully replaced. The VRF system paired with HRV complies with the current energy code, is appropriate for this facility, and has a good combination of low first cost and energy efficiency. However the following details were not included in the proposal and should be defined clearly:

- No specifics were provided about where the HRVs will be located or how they are ducted to the system and air delivered to the spaces. A catalog cut was provided for the equipment but no other data.
- There is no detailed information on the VRF equipment model numbers.
- No mention of using VRF controller boxes to distribute refrigerant to the zone fan coils and provide heat recovery to save compressor energy.

- No capacities are provided for system heating and cooling.
- No indication of calculations being done as part of the design. Cannot use existing equipment capacities for this.
- No indication of how the 9 zones are being allocated. Recommend that more zones be provided for better comfort. Ceiling mounted cassettes can also be used in certain areas where appropriate, like offices and exam rooms. Ceiling cassette dimensions should be checked to verify there is enough space under the joists for installation.
- Did not see that system TAB and Commissioning is provided. See discussion on Commissioning later in the report.
- Proposal states that prevailing wages are not included. Pricing needs to include prevailing wages.

Schedule says the system can be built 4-6 weeks after acceptance but provides a caveat that depends on availability of equipment, labor, and permit period. The 4-6 week timeframe does not seem realistic and the statement is open-ended and needs clearer definition.

The payment terms indicates a 50% down payment with remainder due as work progresses. In commercial construction payment is typically entirely based on progress of the work. Do not recommend a down payment for work not done.

## 4.3 COMPARING THE HVAC PROPOSALS

As stated above, there is no way to adequately compare the proposals because they are not based on the same type of HVAC system nor are they structured the same. Deficiencies that the proposals have in common are: the proposals are out of date and need to be updated, neither proposal indicates drawings be provided for owner review and approval and check that maintenance access provided, neither proposal addresses the work sequencing and keeping the building operational, and no warranty is provided for equipment and labor, industry standard is 1 year from substantial completion.

Between the two HVAC proposals, the Sage proposal is closest to the total building solution that is expected, but as stated previously there are many aspects that need refining. The Sage pricing provided for the total building HVAC solution seems low at $31.6/sf, but understandable considering its 2 years old and does not include everything needed for the project. We would expect a competitive bid for a VRF/HRV system to be $40/sf for the HVAC piece only. There are also some cost reduction strategies that can be stipulated in an RFP (see below for RFP explanation). For example the proposal indicates providing two HRV units, there could be an option to provide only one HRV unit which could be listed as an alternate to see what the difference in cost is. A rough-order-of–magnitude (ROM) cost savings is about $10,000 to $15,000 by going from two HRVs to one HRV.

While obtaining low bids is the goal, without full detail on what is being provided for that bid, corners can be cut during construction and the end result is not as expected. The recommended approach for the upcoming project is to prepare a formal Request for Proposal (RFP) that lists requirements for the design and construction that adheres to the OIHCD's requirements for HVAC, roofing, and how the two projects are tied together as one. This RFP can be sent out to bidders and expected that the pricing received will be for the same scope of work so a proper comparison can be made and a contractor selected. See Section 6.1 for more discussion of this.

# 5. ROOF THERMAL BARRIER AND PRESSURE BARRIER

## 5.1 EXISTING CONDITIONS

The roof is hip style with a 12/6 slope and one dormer. There are extensive overhangs around the building that make the roof footprint area around 8,600 sf creating enclosed eaves. The wood truss framing is spaced 24" on center and creates an attic space with sufficient walking head height under the peak. The attic is vented using a system of screened vents at the underside of the eaves and ridge vents at the peak. One-hour rated fire walls and draft stops are provided to separate the attic areas and to separate the attics from the space in the eaves.

In order to clarify terminology we use the following definitions: *pressure barrier* is a barrier that prevents air movement, *thermal barrier* is insulation, and *vapor barrier* is a barrier that prevents both moisture intrusion and air movement.

The existing thermal barrier consists of unfaced R-30 batt insulation located between the 24" on center ceiling joists and held in place by twine attached to the bottom of the joists. In many areas the insulation has been disturbed or is missing entirely. There is no gypsum or plywood sheathing on either the top or bottom of the joists. There is a lay-in ceiling approximately 12" below the joists (dimension should be field verified throughout) that forms a plenum of sorts. There seems to be fiberglass dust suspended in the air both in the attic and plenum. When ceiling tiles are removed some of this dust drops into the occupied space. The lay-in ceiling is not air-tight because the removable tiles rest on a grid and air gaps can occur where the tiles are warped or not set properly. Air also passes through gaps in light fixtures, ceiling diffusers, and other devices in the ceiling. Therefore the lay-in ceiling cannot be considered a pressure barrier.

**Unfaced Batt Insulation Above Lay-in Ceiling**

There are three issues with this overall installation:

- There is no pressure barrier provided for the attic. Since the attic is vented the roof is not a pressure barrier either. Because of this the air exchanges freely between the unconditioned attic and the conditioned space, this is called infiltration. This results in heat, moisture, and particle transfer between the attic and occupied spaces that counteracts the performance of insulation and HVAC systems.

- Areas where the insulation is disturbed or missing short circuits the thermal barrier and allows unwanted heat loss and heat gain.
- The indoor HVAC equipment is located in the unconditioned attic which is allowed, but not considered ideal. The large seasonal temperature fluctuations in the attic require additional insulation wrap for the ducts and AH units (per the energy code) and exposure to these temperatures can shorten the equipment life. Also, if the ducts are not sealed properly the infiltration issues outlined above will be increased. Based on observations the ducts do not appear to be adequately sealed.

These issues greatly impact building energy consumption and occupant comfort and should be addressed during the reroofing project.

## 5.2 ROOF AND ATTIC RENOVATION OPTIONS

It is the intent of the OIHCD building committee to replace the existing shake roof. This creates an opportunity to repair the thermal and pressure barrier issues outlined above. There are two general approaches that can be taken: convert the existing vented attic to an unvented attic, or keep as a vented attic and provide the proper pressure barrier. The following is a work outline for each approach. The diagrams provided are meant to illustrate the concept of each roof assembly, not meant as an exact application to this project.

Convert To Unvented Attic:

- Remove the existing batt insulation between the joists.
- Remove the ridge vents.
- Remove the eave vent transfer ducts to the attic and block the openings. The vents within the eaves can remain.
- Build-up the roof to apply insulation in one of the following methods, see Figures 1-3 below:
  - Continuous R-38 rigid insulation layer above the deck.
  - Combination rigid insulation layer and batt insulation layer. The maximum U-value for the assembly not to exceed U=0.021 per code. This option may be attractive if current roof structure cannot support weight of insulation entirely above deck.
  - Provide spray foam insulation under the deck. The maximum U-value for the assembly not to exceed U=0.021 per code. This option may be attractive since current roof deck is being maintained and could provide an installation with minimal structural modifications.
  - Provide vapor barrier for each.
- Improve the maintenance access to the attic by providing framed openings in the ceiling that are not obstructed by framing or ductwork. Also relocate access points to not interfere with clinic operations.
- Recommend providing plywood walking platforms in the attic secured to the open joists. Platforms to extend from the attic access points to the HVAC equipment for fall prevention safety and ease of maintenance.

**Figure 1: Rigid Insulation Above Deck**

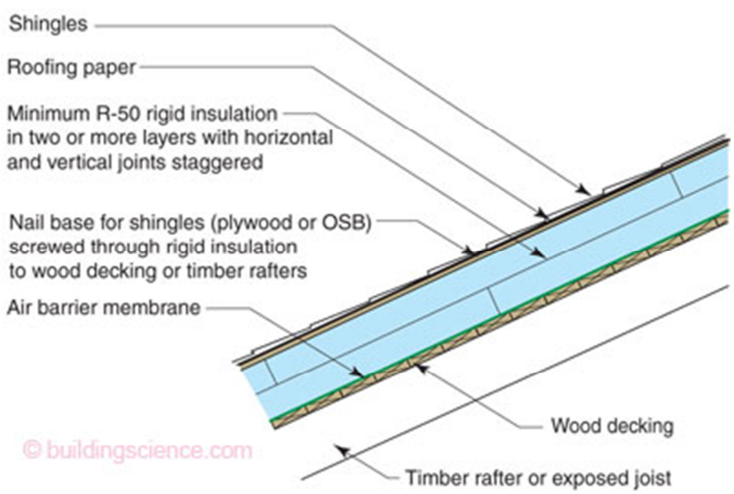



**Figure 2: Rigid Insulation Above Deck and Batt Insulation**

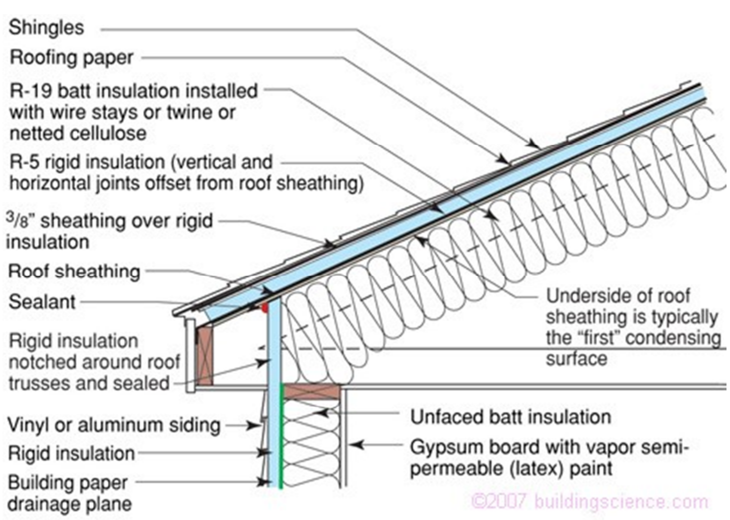
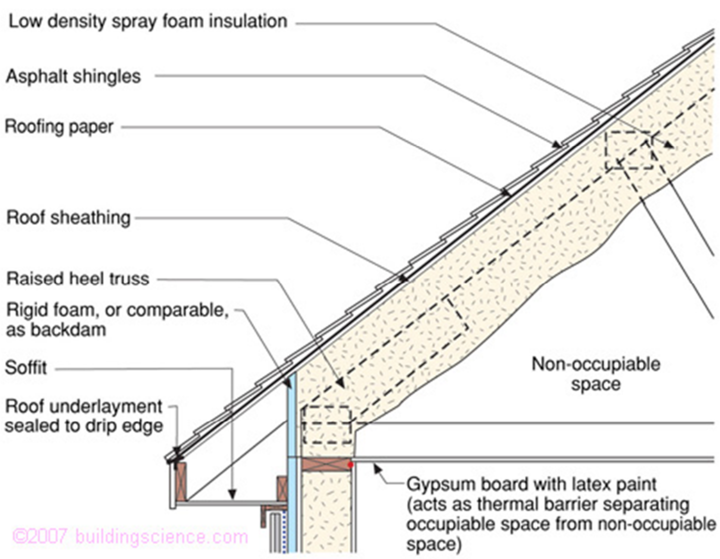


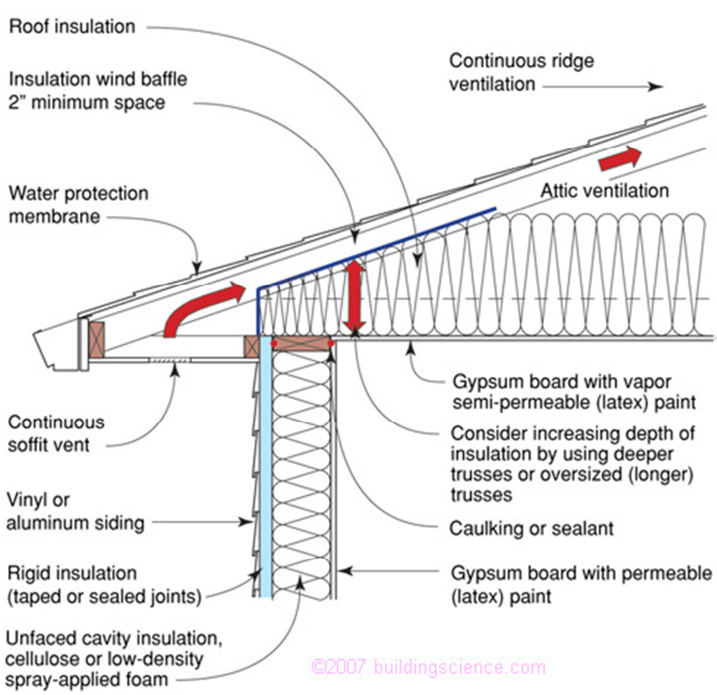
**Figure 3: Spray Foam Insulation**




Repair Existing Vented Attic:

- Remove the existing batt insulation between the joists.
- Provide continuous gypsum board secured to the bottom of the ceiling joists with a vapor barrier. Construct to cover all openings so air cannot transfer between the attic and occupied space. Refer to Figure 4 below.
- Install R-49 batt insulation in all joist cavities.
- All penetrations through the gypsum (duct, pipe, etc.) to be sealed airtight with caulking. There is not enough space to run ductwork between the pressure barrier and the lay-in ceiling.
- If existing HVAC systems remain and are not replaced, repair all air seals on ductwork and replace duct insulation to meet current code for outdoor installation.
- Same attic access and platform recommendations as above.

**Figure 4: Vented Attic Insulation and Vapor Barrier**



Based on available information for the building, the options listed above appear to be feasible. In comparing the benefits and drawbacks of each it is recommend to convert the existing vented attic to an unvented attic using the rigid insulation above deck method. This is assuming the existing roof structure can support the added weight of the insulation. The following are the reasons for the recommendation:

- HVAC equipment is protected from temperature swings that reduce service life.
- Work should be almost entirely outside and in the attic, less impact to occupants compared to adding the gypsum to the underside of the ceiling joists.
- No penetration of the pressure barrier is needed which increases its effectiveness.
- A drawback is with an unvented attic the roof surface will be slightly warmer which impacts shingle life. A general estimate is that there will be a 10% reduction to the life of the new shingles.

Recommend that the accepted approach be carefully investigated and detailed for construction by an architect and structural engineer as part of producing an RFP for contractor bidding.

# 6. CONSTRUCTION

## 6.1 CONSTRUCTION AND SUPPORT SERVICES

The construction delivery method that is recommended for this project is to provide an RFP containing the entire project scope for open bid by general contractors (GC) the goal is to obtain at least 3 competitive bids. The main purpose of the GC is to manage the overall project and hire subcontractors to provide the design documents and construction of the mechanical, electrical, and roofing scopes of work. In some cases the GC can also perform the roofing work. An alternate construction delivery method was considered, to hire a general contractor/construction manager (GC/CM) up front that would plan the construction phasing/schedule, provide project budgeting, and help prepare the RFP prior to soliciting sub-bids and would conduct the competitive bidding process for the sub-work. However, the process to hire a GC/CM using the State of Washington guidelines is a considerable amount of effort and cost and does not seem appropriate for this project.

In addition to bidding the project and hiring a GC, there are some other design and construction support services that should be considered for this project. These services can assist the OIHCD in making sure the project has a successful outcome. Note that the ROM costs provided for these efforts are not a proposal and are provided for planning purposes only. The costs provided are considered to be a maximum and the extent of the service can be scaled back.

- Recommend that an Architect/Engineer be hired to help prepare the RFP. It is assumed the RFP would include front-end contractual language along with scope narratives and schematic drawings for HVAC, electrical, architectural, and structural. It was expressed during meetings that there may be some architectural layout changes that need to be incorporated in the RFP. The medical facility also has specific design criteria such as not leaving bare spots on walls which need to match existing wall paper. Some other specific design elements that can be captured: locate equipment outdoors if possible for easier access, and improve the access to the attic equipment for maintenance. ROM cost for this RFP effort is approximately $30,000 for all trades. Assume that architectural/structural is hired separately from mechanical/electrical.
- Recommend meeting with the building department to clarify applicable codes. Typically aspects of the building that are being renovated will need to meet the current codes; items that are not renovated can remain. Also will need to review if there are local substantial alteration requirements. This means that if the renovation is substantial enough then the entire building needs to be brought up to code. There are not many jurisdictions outside the City of Seattle with these requirements but it should be checked. This should be done as part of the RFP development process.

- The RFP will indicate that the contractors will provide design drawings for permitting. Recommend a peer review process for the mechanical design drawings. This includes the Mechanical Engineer reviewing the drawings for adherence to the RFP requirements and for maintenance access. Comments would be provided to the contractor to make changes and the final set back-checked. ROM cost for this effort is approximately $5,000.
- Recommend that an Architect/Engineer be hired to perform construction administration (CA) services to assist the Owner with technical support, communications with the GC, addressing issues that arise during construction, and to verify the construction is progressing according to the Owner's requirements in the RFP. Some specific services include: review contractor bids, review product submittals, respond to requests for information (RFI) from the contractor, attend two site meetings, attend monthly conference call meetings, punchlist review and back-check, and review operation and maintenance manuals (O&M) provided by the contractor. ROM cost for this effort is approximately $25,000 assuming a 6 month construction schedule.
- Recommend that a 3rd party Commissioning Agent (Cx) be hired for this project. Commissioning is the process of verifying that the HVAC systems operate as intended. Sometimes there is a defective piece of equipment installed by mistake or the contractor does not complete the controls programming and this is not known until after the project is closed out and comfort issues arise. The Commissioning process will conduct field tests of all the equipment and systems to verify the equipment and controls are operating properly. This work includes: reviewing the contractor design and submittals, writing a plan with test procedures, conducting site kick-off meeting with contractors, conducting functional testing at each phase of work, attend two conference call meetings, and provide final report. ROM cost for this effort is approximately $20,000. This work can also be done by the contractor, but we have found the process is not as effective in finding and fixing problems when not a 3rd party.

## 6.2 PROJECT COORDINATION DURING CONSTRUCTION

As previously stated, the clinic must remain operational during construction and the impact of the work on the occupants must be minimized. For this to occur, the HVAC portion of the work must coordinate with the reroofing portion of the work. Here are some proposed strategies to accomplish this:

- The entire construction project is to be managed by one "prime" contractor, as outlined above, for all trades. The prime contractor needs to be responsible for the project scheduling and coordination of all trades.
- Schedule most of the work to occur in the late spring or the early fall when temperatures outside are not too hot or too cold. This will minimize the supplemental heating and cooling that needs to be provided during shut-downs. The roofers can work in the rain if needed by doing the work in sections. Tarps can be used to protect work areas as needed.
- Coordinate opening the roof as required to remove old HVAC equipment, and bring new materials into the attic.
- Since the building is divided into 4 distinct wings, one wing could be closed down and occupants moved to another area of the building temporarily while work is done in the wing they normally work in. The exception to this is the East wing which may need to stay open due to the walk-in care and procedure rooms needing to remain operational.
- Work can be done after business hours on weekdays and/or on weekends.
- Temporary heating and cooling units can be provided for the spaces while HVAC shut-downs occur.
- Select new equipment like the HRV unit to be rated for installation outside at grade to help reduce the amount of work within the building.
- There appears to be enough space in the attic to install the new HVAC system over the existing system. The existing system is maintained and operates until the new system is ready, then a switch-over occurs. The switch-over can occur in phases, one wing at a time, for instance. The old system is removed after the corresponding portion of the new system is brought on-line.

Some combination of multiple strategies will need to be implemented to meet the goals. This will need to be detailed in the RFP document so the bidders are aware of these goals. There will be additional costs associated with these strategies for both the contractor and the Owner compared to having the building unoccupied.

## 7. REBATE INCENTIVES

There was a meeting with representatives from Orcas Power & Light Co-op (OPALCO) to discuss potential rebates related to the renovations that can be used to help offset some of the renovation costs. OPALCO indicated incentives are available for the type of HVAC upgrades and insulation upgrades that are being considered for this facility. OPALCO provided context for the amount of rebates that are typically provided, with the average rebate being $2,400. A high end rebate is considered to be $20,000. Rebates are paid when the work is completed.

The OPALCO rebate programs are on a 2 year update cycle which renews on October 1st. OPALCO doesn't believe the next cycle will be much different than the current cycle. The primary method for obtaining rebates is to complete the forms available on the website and send to OPALCO for review. There is a menu of incentives for different HVAC equipment and insulation upgrades that are used to calculate the total rebate. The OPALCO website has an extensive list of approved products for incentive. There is also a process to add inverter driven equipment if not already on the list, if needed. The website also indicates that the work must be done by an approved contractor listed on their site in order to receive a rebate. Need to explore if there is a process to add contractors to the list as well.

The relevant incentives for this project were discussed as follows: the heat pump replacement incentive is $800 per ton of cooling if the equipment is on the approved list, thermostat replacement is $200 each, and for insulation the incentive range is $0.45 - $0.90 per sf of insulation. If the roof insulation is upgraded to R-38 continuous, it was estimated the incentive would be $0.85 per sf.

Using the criteria above, here is an estimated rebate for the projects discussed:

| | |
|---|---|
| Current building cooling capacity, 14.5 tons x $800 | =$11,600 |
| Replace 4 thermostats x $200 | =$800 |
| Roof insulation, 6,000 sf over occupied areas x $0.85 | =$5,100 |
| Total | =$17,500 |

OPALCO indicated that they are adding VRF systems to their approved list of equipment. If the scope of the project ultimately leads to proposed systems that do not appear on the approved list, OPALCO will evaluate the design and calculate a rebate based on an energy analysis. The energy analysis will be done by the Bonneville Power Administration (BPA) at no cost to Owner. Design documents, building information, and hours of operation need to be provided to complete the analysis. The average response time is 2 weeks. The predicted energy use of the new design will be compared to existing power usage. Criteria for determining the rebate is a case by case basis, therefore this is difficult to predict and they may or may not provide an incentive.

It is the opinion of Hargis that while the incentives are not significant compared to the expected renovation costs, the incentives should be pursued because there is minimal effort to obtain them, mainly filling out application forms. BPA will provide energy analysis if required which is a benefit. Other utilities in Washington State require the customer to provide extensive energy analysis at high cost that negates much of the incentives.