ST. MARY BASILICA – HVAC RENOVATION
ARCHDIOCESE OF HOUSTON & GALVESTON
HOUSTON, TX

EXISTING BUILDING COMMISSIONING

COMMISSIONING REPORT & MANUAL

THE ARCHDIOCESE OF GALVESTON-HOUSTON

Prepared For: St. Mary Parish

Prepared By: NORESCO

Submitted: December 2020

Commissioning Report

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Appendices:

A. Commissioning Plan
B. Executed Installation and Functional Checklists
C. Identified Issues

I. Executive Summary

The St. Mary HVAC renovation project is a major HVAC retrofit to an existing campus. All HVAC equipment has been procured as new for this project.

NORESCO was hired as the commissioning agent, and was involved in the acceptance, and post-acceptance phases of the project, and assisted with the commissioning requirements for the 2015 International Energy Conservation Code. Commissioned systems included: Heating Ventilation and Air Conditioning system. The following systems/equipment were commissioned:

- Air Handler Units
- Dedicated Outdoor Air Unit

A total of 3 commissioning deficiencies (issues) were identified and were able to be resolved on site. The testing procedures covered testing of sequence of operations, verification of all major HVAC components (cooling, heating, economizer, sensor calibration), indoor air quality assurance, digital/analog communication between equipment and controls, and basic conformance to the design plans and specifications. Some of these issues are summarized below:

Each site visit serves to allow for different tasks to be completed at the appropriate time. Site Visit tasks in their simplest manner are as follows:

- Site Visit 1 – Commissioning kick-off meeting
- Site Visit 2 – Installation checks to verify installation of equipment
- Site Visit 3 – Functional checks to verify the functionality of store HVAC equipment

The major issues uncovered during the course of testing were:

- **AHU4 could not activate heating mode upon command.**

Additional details regarding these issues can be found in Section III of this report.

NORESCO recommends the following ongoing actions to sustain the reliability and performance of the facility.

- **Create a continuous Commissioning plan where the building and statue systems are re-commissioned every 24 months.**
- **Implement on-going training for operations staff.**
- **Perform equipment maintenance according to manufactures recommendations.**
- **Calibration of sensors/actuators every 24 months or earlier.**

NORESCO worked with the project team, to resolve nonconformance, operation and documentation issues. These issues were documented and tracked throughout the project and closed once addressed by the respective sub-contractors, and verified as resolved.

Complete details corresponding to the following sections may be found in the appendices of this report.

Respectively submitted,

Eric Granhaug
Staff Engineer
NORESCO, Inc.

II. Introduction

A. Project Background

The renovation of the HVAC system took place in Galveston, TX as a renovation of HVAC equipment on St. Mary's existing campus. All HVAC systems in the church were replaced with new systems and a dedicated outdoor air unit was added.

The building HVAC system features air handling units throughout the church and a dedicated outside air unit that mixes return air with treated outside air.

Commissioning Goals
The goal of commissioning is to ensure that the Owner is provided with a fully functioning building and its systems that can be operated and maintained in conformance with the Owner's expectations and operational needs. These operational needs are the objectives of the commissioning process and are listed below:

- ✓ Ensure a comfortable thermal environment for occupants and equipment.
- ✓ Ensure operation and sequencing of installed systems meet design requirements.
- ✓ Ensure system / equipment reliability.
- ✓ Optimize building energy and maintenance costs.

B. Commissioning Program Review

The commissioning process includes several phases and multiple parties during each phase. The process is broken out into three phases, Design, Construction and Acceptance. These phases and the included procedure are defined in the following.

Design Phase
The Cx process began with a commissioning plan developed by NORESCO. The commissioning plan describes the commissioning process, assigns roles and defines expectations.

Construction Phase
Once construction began, Site Visit 1 and 2 were performed to perform the commissioning kickoff and to review installation of the equipment and associated system components to be commissioned on the project. Any deficiencies found during the construction phase were placed on the issues database for tracking and issue resolution.

Acceptance Phase.
This phase incorporates Site Visit 3, where systems are checked for operation, performance and final installation review. Deficiencies found during this phase were

relayed directly to the construction management team and associated contractors for an expedited repair. Any issues found were logged in the issues database for tracking purposes.

III. System Deficiencies and Resolutions

Throughout the course of the commissioning process items would be discovered that do not match the project requirements and/or construction documents. These items are classified as issues, and are noted in the SmartSynq Issues Database for tracking and resolution. During this project, three (3) issues were identified. NORESCO worked with the Controls Technician, the Mechanical Contractor and the General Contractor to resolve all identified issues during the site visits. At the date of this report, all issues have been addressed.

The ability to resolve all issues is a result of the ongoing coordination and communication between the CxA and the various members of the construction team.

Of the 3 issues discovered, the following issues are a few of the more significant issues, and could have resulted in compromised facility performance.

- **AHU4 heating could not be activated when commanded.**

During the final walk through after the control system was installed by 75F, no immediate deficiencies were found however a few suggestions are recommended to improve the comfort of the building.

- Consider adding wireless sensors away from exterior walls for thermostats to read. Thermostats mounted on exterior walls have been reported to read elevated temperatures from the walls.
- Consider adding a temperature deadband to the 'auto' comfort setting. This would improve comfort and save energy particularly for times of the year when the temperature fluctuates in excess of 30F during the day. This deadband should also be increased during non-occupied hours. The current setting of 70/77 during occupied/unoccupied hours during the winter will lead to excessive heating overnight.
- Consider adding summer/winter/special event schedules to the programming. Current schedule is 70F from 6:30 am to 6:00 pm.
- Consider a global lockout of cooling/heating based on outside air temperature conditions to prevent simultaneous heating/cooling.
- Consider revising humidity averaging formula for building humidity sensors. Spaces near exterior doors may experience excessive humidity when the average humidity in the building is low.

AHU4 Heat Mode Malfunction

It was discovered that AHU4 had bad contactors on the heating side and could not activate heating. This air handler serves roughly half of the church and would result in significant occupant discomfort during cold weather.

IV. Commissioning Process and Results

The commissioning process for the St. Mary HVAC Renovation began at the design phase of the project and continued through building turnover. The planning and design phase serves to integrate the commissioning requirements, design review, construction documents and drawings. During the construction phase, the CxA performed the installation checks, the functional checks and logged all issues into database. Prior to turnover, the construction team worked to resolve the issues identified during the Cx effort. The following areas were addressed during this project:

- ✓ Commissioning Plan
- ✓ Installation Inspection & Verification
- ✓ Functional Performance Tests
- ✓ Issues Database
- ✓ Issue Closeout

A. Commissioning Plan

A commissioning plan was developed by the CxA during the design phase which outlined the commissioning process throughout the duration of the project, as well as all of the team players with their roles and responsibilities. A copy of the Commissioning Plan can be found in Appendix A.

B. Installation Inspection and Verification

During construction, NORESCO conducted site inspections, and worked with contractors to ensure that all commissioned equipment were installed in conformance to the contract documents, and CVS's best practice guidelines. These inspections were documented in the Installation Check Sheets which reside within the Smartsynq platform. Any discrepancies or issues would be added to the issues database maintained on Smartsynq. The Executed Installation Check Sheets can be found in Appendix C.

C. Functional Performance Tests

Once equipment had been properly started, balanced and programmed, NORESCO performed a site visit (Site Visit 2) to test and verify the operation and performance of all commissioned systems. As each component was tested and verified, the results were recorded on the relevant Functional Test Sheets which are found in Smartsynq. If an item could not be successfully tested, an issue would be added to the issues database. Copies of the completed Functional Test Sheets are provided in Appendix B.

Some of the more substantial issues identified during the functional testing have been listed in Section II of this report.

D. Issues Database

One of the most important tools used to manage the commissioning process is the issues database. All issues found during construction and acceptance phases were recorded and tracked on the issues database on SmartSynq until resolved by the contractors and verified by the CxA as closed. For a complete list of all issues found during commissioning, refer to Appendix C.

E. Issue Closeout

Seasonal testing ensures that systems that function in different seasons such as cooling and heating are properly tested during commissioning. At this time, there are currently no additional plans for seasonal testing. This should not pose an issue as all conditions were tested during the Cx process including heating, cooling, economizer mode, and dehumidification modes.

V. Summary of Training

After the equipment is commissioned and verified to be installed and functioning correctly, it is important to train the building operators to ensure the proper operation and maintenance of the equipment. Training is particularly valuable to optimize energy efficiency and optimize the life of the building equipment.

The Archdiocese of Houston & Galveston has a standardized training program that all building operators must participate in prior to the facility opening. Additionally, ongoing training is provided as building technology and equipment is updated.

VI.Recommendations

Overall the project was successful when the complexity of the project is considered. We have the following recommendations to ensure systems continue to operate at optimal efficiency and retain reliability.

- **Create a continuous Commissioning plan where the building and statue systems are re-commissioned every 24 months.**
- **Implement on-going training for operations staff.**
- **Perform equipment maintenance according to manufactures recommendations.**
- **Calibration of sensors/actuators every 24 months or earlier.**

VII. Warranty Testing/Inspection

In July of 2021 a warranty visit was conducted to check on the status and functionality of the equipment. Light testing was performed, the summary and table below reflect the results of this visit. Archdiocese staff was present for the testing however a mechanical contractor was not available so some testing was not possible during this visit.

Summary:

The majority of the equipment in the church was running and the BAS was manipulated to put the units into cooling and then heating to test functionality. Outdoor temperatures were above 90 degrees, so some units did not cycle to heating and these have been noted. The AHU numbering/identification aligns with the 'HVAC Plan and Schedules' depicted on M-2 of the drawing set dated 4/29/20 – For Approval. Note: DOAS unit was not able to be tested at this time, no mechanical contractor was available.

Results:

Table 1: Warranty Testing Results

TAG	Cooling (Previous)	Cooling (Tested)	Heating (Previous)	Heating (Tested)
AHU-1	53	44	91	88
AHU-2	55	44	92	[1]N/A
AHU-3	55	[2]N/A	109	[2]N/A
AHU-4	55	60	90	68
AHU-5/6	54	65	90	76

[1] Unit heat did not activate due to satisfied thermostat

[2] Unit was not functional

The issues database/log has been updated to reflect the results indicated above. NORESCO will coordinate with the GC and the Archdiocese to address the findings.

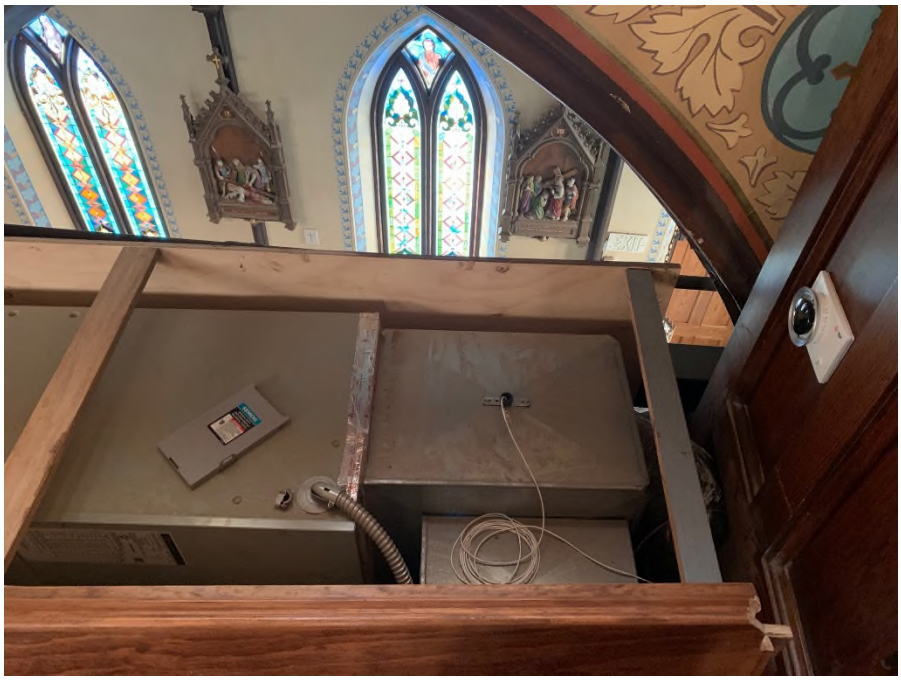

Figure 1: AHU-3 in loft area, not functional

APPENDIX A
Commissioning Plan

Commissioning Plan - Draft

St. Mary Basilica
2011 Church St.
Galveston, TX 77550
2015 IECC Commissioning

Prepared by:
NORESCO
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Prepared on:
April 1, 2020

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PREFACE

NORESCO — an energy engineering and sustainable design consulting firm located in Houston, TX — prepared this document for the St. Mary Cathedral located in Galveston, TX.

1 OVERVIEW

Table 1-1: Revision Record

Revision	Date	Description & Summary of Changes	Date
0.1	Initial Draft	From design review and prior to Cx Kickoff Meeting	4/1/2020

1.1 Abbreviations and Definitions

The following table lists the common abbreviations used throughout this document.

Table 1-2: Abbreviations and Definitions

A/E	Architect and Design Engineers	FPT	Functional Performance Test
CxA	Commissioning Authority	GC	General Contractor
CC	Controls Contractor	MC	Mechanical Contractor
GC	Construction Manager	MFR	Manufacturer
Cx	Commissioning	OR	Owner's Representative
ME	Mechanical Engineer	PFC	Pre-Functional Checklist
Cx Plan	Commissioning Plan Document	LGT	Lighting Designer
EC	Electrical Contractor	Subs	Subcontractors to General
MM	Maintenance Manager	TAB	Testing, Adjusting, and Balancing Contractor
EE	Electrical Engineer	Staff	Building Maintenance Staff

Where the term "contractors" is used in the Cx Plan, it refers to the GC or GC and/or Subs as appropriate.

1.2 Purpose of the Commissioning Plan (Cx Plan)

The purpose of the Commissioning Plan (Cx Plan) is to define the commissioning process during construction, providing resolution for issues such as scheduling, roles and responsibilities, lines of communication and reporting, approvals, and coordination.

The project Commissioning Specification (Cx Spec), which will be included in the project's Contract Documents, will provide a detailed breakdown of construction-phase commissioning tasks and the contractor's requirements for completing these tasks. This Cx Plan supplements the commissioning specification by providing additional information regarding the roles and responsibilities of the other Cx team members and also outlines Cx activities planned for the design and post-occupancy phases of the project.

1.3 Commissioning Goals and Objectives

Commissioning is a systematic process of verifying that the building systems perform according to the Basis of Design (BOD) and the Owner's Project Requirements (OPR). All equipment and systems should be installed according to manufacturer's recommendations, the best practices and standards of the industry, and the Contract Documents. The Cx process must meet the 2015 International Energy Code requirements for commissioning.

Commissioning involves documenting all commissioning activities during the Construction and Acceptance Phases of the project. The participation of the contractors in commissioning activities will follow the requirements defined in the construction specifications. The three main goals of the commissioning process are as follows:

1. Facilitate the final acceptance of the project at the earliest possible date.
2. Facilitate the transfer of the project to the owner's maintenance staff.
3. Verify that the comfort systems meet the requirements of the owner.
4. **Verify that the Owner's operating personnel are adequately trained.**

Commissioning is also intended to achieve the following specific objectives:

- Verify and document that the equipment is installed and started per manufacturer's recommendations and to industry accepted minimum standards.
- Verify and document that equipment and systems receive complete operational checkout by the installing contractors.
- Verify and document system performance with thorough functional performance testing.
- Verify the completeness of operations and maintenance materials.
- Verify that the owner's operating personnel have received adequate training on the operation and maintenance of building equipment.

1.4 Overview of Commissioning Process

- The main elements of the Cx Process are listed below.
- Verify documentation of the OWNER's Project Requirements and Basis of Design: The owner's representative develops a document that clearly states the OWNER's project requirements. The Basis of Design document details the Design Team's response to the performance criteria in the Owner's program and OPR report.
- Review OWNER's Requirements and Basis of Design (Design Intent): The Commissioning Authority (CxA) reviews these two documents to ensure they are in alignment.
- Commissioning Specifications in Bid Documents: Include the contractor's commissioning responsibilities in the bid documents in the form of a Commissioning Specification.
- Commissioning Plan and Kickoff: Develop a Cx Plan that outlines the Cx Process and describes Roles and Responsibilities of Cx Team Members and present the plan to the Cx team. Provide a construction scoping and kickoff meeting that will bring together all members of the design and construction team that will be involved in the commissioning process.
- Installation Verification: Verification that equipment and systems are installed according to plans, specifications and manufacturers guidelines to result in proper performance and will be filled out by the appropriate sub-contractors.
- Start-Up and Checkout: Verification that equipment Start-Up and Checkout is completed and documented per the equipment manufacturer's recommendations including controls point-to-point checks and calibrations.

- Functional Testing: Verification that operational performance of equipment and systems complies with the contract documents, and meets the OWNER's need for a 'complete and functional facility'. A seasonal test shall be conducted by the CxA within nine months of project completion.
- Issues Logs: Any of the results of the Pre-Functional Checklists, Functional Tests, and monitoring that are found non-compliant with the drawings or specifications will be included in a report. This report will document the non-compliant issue, the corrective measure to fix the issue, and who is responsible for making the corrective action. This is a living document that will be continually updated.
- Owner Training: Verify Operation and Maintenance staff is appropriately trained.
- Systems Manual: Provide a Systems Manual which includes all information required to effectively maintain the building at optimal performance.
- Commissioning Report: Provide a Commissioning Report, which incorporates documentation of the commissioning process.

1.5 Energy Code Compliance - Commissioning

The commissioning effort for this project has been designed to meet the 2015 IECC commissioning requirements. The code review items are due upon review of the plans for approval, while the permitting items are due at the end of the construction period for final occupancy permitting.

Cx specific code review items are as follows:

1. OPR and BOD
2. Cx Measures in Construction Documents.
3. Cx Plan

Cx Specific permitting items are as follows:

1. O&M/Systems Manual.
2. Functional Performance Test Compliance.
3. Documentation and Training Compliance.
4. Cx Report Compliance.
5. Site-Built Fenestration/NFRC GCA Review.
6. Irrigation and Water Re-Use System Allowance.

1.6 General Building Information

Table 1-3: General Building Information

Project Name	St. Mary Basilica
Project Address	2011 Church St., Galveston, TX 77550
Building Type	Existing Building / Renovation
Building Description	Historic Building, Church

1.7 System and Equipment to be Commissioned

The systems and equipment summarized below are included in the commissioning scope of work. They are systems in the Core and Shell project scope. These systems are provided in the original design intent as provided by the OPR and BOD. Equipment will be tested after checkup and start up is complete to the requirements listed in the design documents. All testing will be documented and included in the final report and O&M documentation. Sample form attached to this document.

Table 1-4: Systems to be Commissioned

System Equipment	Project Quantity	Sampling Rate	Sampled Quantity
Air Handling Units	6	100%	6
Dedicated Outdoor Air Unit	1	100%	1
Building Management System	1	System	

1.8 Design Intent

As defined by the OPR and BOD, the commissioning objective will achieve the owner's desire of compliance with the 2015 IECC as well as the performance criteria listed in the OPR.

2 ROLES AND RESPONSIBILITIES

2.1 General Management Plan

The CxA coordinates all commissioning activities and reports to the Owner and the Architect of Record. The CxA, whether contracted through the design team or otherwise, is accountable to the building owner to coordinate the delivery of a fully functional building in alignment with the Owner's Project Requirements and the Contract Documents.

The CxA's responsibilities, along with the designation of the Cx team, are described in Section 2.2 and 2.5. The Cx process will require the coordinated effort of all members of the Cx Team in order to meet the objectives of the Contract Documents.

2.2 General Descriptions of Roles of the Cx Team

A general description of the role of each member of the commissioning team is presented in the table below:

Table 2-1: Cx Team Roles

CxA	Coordinates the CX process, writes and reviews testing plans, directs and documents performance testing
A/E	Perform construction observation, approve O&M manuals and assist in resolving problems
Owner, OR	Responsible for final approval of the CX work
MM	Coordinates maintenance staff participation in commissioning activities
Staff	Participate in commissioning tasks and performance testing, review O&M documentation, and attend training
GC	Facilitates the CX process, ensures that Subs perform their responsibilities and integrates CX into the construction process and schedule
Subs	Demonstrate correct system performance
TAB	Test Adjust and Balance appropriate systems, as outlined in TAB contract
MFR	Equipment manufacturers and vendors provide documentation to facilitate the commissioning work and perform contracted startup

2.3 Construction Specifications and Commissioning

The commissioning language in the construction specifications and in this commissioning plan details the commissioning requirements for this project. The following lists the sections of the specifications that include commissioning related language with a brief description.

- Section - Submittal Procedures
- Section - Project Closeout
- Section - Closeout Submittals
- Section - Operation and Maintenance Data
- Section - Demonstration and Training
- Section - Commissioning
- Section - Testing, Adjusting and Balancing for HVAC
- Section - Commissioning of HVAC
- Section - Instrumentation and Control for HVAC

2.4 Protocols for Commissioning Team Communication and Issues Resolution

The following protocols will be used for formal communications between the commissioning team members and for resolving issues on this project.

Table 2-2: Communication Protocol

Issue	Protocol
For requests for information (RFI) or formal documentation requests	The CxA goes first through the GC and the Owner
For minor or verbal information and clarifications	The CxA goes direct to the informed party
For notifying contractors of deficiencies	The CxA documents deficiencies through the GC and the Owner
For scheduling functional tests or training	The CxA provides input and coordination of testing and training. Scheduling is done through the GC
For scheduling commissioning meetings	The CxA selects the date and schedules through the GC and Owner
For making a request for significant changes	The CxA has no authority to issue change orders
For making minor changes in specified sequences of operations	All changes in sequences of operations required must be approved by the A/E. The CxA may recommend changes in sequences of operation to correct operational deficiencies and/or to improve efficiency or control.
Subcontractors disagreeing with requests or interpretations by the CxA	Resolve issues at the lowest level possible, first with the CxA, then with the GC and Owner. Some issues may require A/E input.

2.5 Team Contact Information

Table 2-3 includes the design and construction team contact information.

Table 2-3: Team Members and Contact Information

Team Member/Role	Name, Role, Phone Number
Owner/Owner Rep – Archdiocese	Steve Faught
CxA - NORESCO	Eric Granhaug, Project Manager, Engineer, 713.457.2173
General Contractor– Z6 Consulting	Lidija Bikova, lbikova@z6consulting.com
Mechanical Engineer – Dega Engineering	979.774.0355
Electrical Engineer – TBD	TBD
Mechanical Sub – Roberts Air	409.740.3988
Electrical Sub - TBD	TBD
Controls Sub - TBD	TBD

2.6 Commissioning Team Responsibility Matrix and Descriptions

The responsibilities of each member of the commissioning team are provided in this section. A Responsibility Matrix is presented first, followed by a written description for each member.

2.6.1 Commissioning Team Responsibility Matrix

Table 2-4: Cx Responsibility Matrix

Legend:

P = Primary responsibility / lead and / or perform activity

S = Secondary or support responsibility / assist the primary team member

R = Review documents and / or approve activities provided by others

Commissioning Team Responsibility Matrix									
P = Primary Responsibility	S = Secondary Responsibility					R = Review & Approve			
Activity	CxA	Owner	A/E	GC	MC	EC/Other	TAB	CC	Notes
Oversee & facilitate commissioning process; serve as Commissioning Team leader	P								
Pre-Design Phase									
Develop Owner's Project Requirements document	R	P	S						
Design Phase									
Develop Basis of Design document	R	P	P						
Prepare Commissioning Plan	P	R	R	R					
Prepare commissioning specifications	P	R	S	R					
Integrate commissioning specifications into the design documents	S		P						
Update the Commissioning Plan	P	R	R						
Coordinate commissioning activities with schedule	P			P	S	S	S	S	
Construction Phase									
Conduct Construction Cx kickoff meeting	P	S	S	S	S	S	S	S	
Integrate commissioning activities into the master construction schedule	S			P					
Attend commissioning team meetings as needed	P	P	S	P	P	P	S	S	
Review and revise Commissioning Plan	P	R	R	R					
Review submittals of commissioned equipment and systems – for project acceptance	R	S	P	S					
Write and distribute Pre-Functional Checklists for commissioned equipment and systems	P	R	R	R					

Legend:
P = Primary responsibility / lead and / or perform activity
S = Secondary or support responsibility / assist the primary team member
R = Review documents and / or approve activities provided by others

Commissioning Team Responsibility Matrix									
P = Primary Responsibility S = Secondary Responsibility R = Review & Approve									
	CxA	Owner	A/E	GC	MC	EC/Other	TAB	CC	Notes
Perform Pre-Functional Check's and submit completed checklists	R	R			P	P		P	
Provide equipment startup procedures	R	R			P	P		P	
Perform equipment startups	R	R			P	P		P	
Prepare and maintain the Commissioning Issues Database	P	R		S					
Witness or review equipment start-ups	R	S		S	P			S	
Perform duct leakage testing	R			R	P				
Perform pipe pressure testing	R			R	P				
Review completed Pre-Functional Checklists	P								
Acceptance Phase									
Provide ladders and proprietary test equipment to CxA as required				P	P	P		P	
Develop Functional Performance Test's commissioned systems and equipment	P	R	R						
Witness Functional Performance Test's commissioned systems and equipment	P				S	S		S	
Provide written responses to open issues in the Deficiencies Log	R		P	P	P	P	P	P	
Update Deficiencies Log	P								
Correction of deficiencies and open issues	R				P	P	P	P	
Prepare TAB plan	R		R				P		
Perform TAB work							P		
Review TAB report	S		P						

Legend:
P = Primary responsibility / lead and / or perform activity
S = Secondary or support responsibility / assist the primary team member
R = Review documents and / or approve activities provided by others

Commissioning Team Responsibility Matrix									
P = Primary Responsibility S = Secondary Responsibility R = Review & Approve									
Activity	CxA	Owner	A/E	GC	MC	EC/Other	TAB	CC	Notes
O&M Activities									
Provide training materials and syllabus				P	P	P		P	
Review training materials	P	S							
Provide training sessions				P	P	P		P	
Attend training		P		P	P	P		P	
Verify and document training	P								
Provide O&M manuals				S	P	P		P	
Review O&M manuals	P	P	P						
Post Acceptance Phase									
Prepare final commissioning report	P								
Prepare Systems Manual	P		R	R	R	R	R	R	

2.6.2 Commissioning Authority (CxA)

The CxA is not responsible for design concept, design criteria, code compliance, general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving deficiencies, but ultimately that responsibility resides with the GC and the A/E team. The primary role of the CxA is to develop and coordinate the execution of a Commissioning Plan to verify and document that systems are functioning in accordance with the Basis of Design and the Construction Documents.

Construction and Acceptance Phase

- Coordinates and directs all commissioning activities. Work with the GC and Owner to ensure that commissioning activities are scheduled.
- Maintain an up-to-date Commissioning Plan.
- Plan and conduct the commissioning scoping (kickoff) meeting.
- Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures, and sequences of operation.
- Develop start-up and checkout plans with Subs. Write and distribute Pre-Functional Checklists.
- Review completed Pre-Functional Checklists and start-up reports.
- Assist with coordination of start-up requirements with TAB requirements.
- Write Functional Performance Test procedures for equipment and systems.
- Coordinate, witness, and document Functional Performance Tests completed by installing contractors. Coordinate retesting as necessary until satisfactory performance is verified.

- Maintain a master deficiency and resolution record. Provide the GC and Owner with written progress reports and test results with recommended actions.
- Provide a Systems Manual.
- Verify that equipment training has been provided to appropriate personnel.
- Prepare a final commissioning report.

2.6.3 Owner

Construction and Acceptance Phase

- Arrange for facility operating and maintenance personnel to participate in commissioning activities and training sessions.
- Provide final approval for the completion of the commissioning work.

2.6.4 Design Team (A/E)

Construction and Acceptance Phase

- Provide Basis of Design and sequence of operation documentation as required by the CxA.
- Assist in resolution of system deficiencies identified during commissioning.
- Provide single line diagrams for commissioned systems.
- Optional: Review equipment start-up and Pre-Functional Checklists. Review Functional Performance Test Plans. Witness performance testing.

2.6.5 General Contractor (GC)

Construction and Acceptance Phase

- Facilitate the coordination of the commissioning work by the CxA.
- Attend commissioning scoping meeting and additional meetings, as necessary.
- Furnish copies of construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.
- Ensure that Subs execute their commissioning responsibilities according to the Constructions Specifications and Drawings and Commissioning Plan.
- Coordinate the training of owner personnel.
- Prepare O&M manuals, according to the Specifications, including updating original sequences of operation to as-built conditions.

Warranty Period

- Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for issues identified during the warranty period.

2.6.6 Mechanical, Electrical, Plumbing Contractors

Construction and Acceptance Phases

- Attend commissioning scoping meeting and additional meetings, as necessary.

- Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
- Assist in clarification of operation and control of commissioned equipment where the specifications control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
- Develop a start-up and checkout plan for all commissioned equipment based on manufacturer's recommendations and pre-functional checklists from the CxA. Submit to CxA for review and approval prior to startup.
- During the startup and checkout process, execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment. Perform and clearly document all completed startup and system operational checkout procedures.
- Resolve A/E punch list items before functional testing.
- Perform functional performance testing, under the direction of the CxA, for commissioned equipment.
- Resolve equipment or system deficiencies and retest as required verifying any modifications.
- Prepare O&M manuals according to the Specifications, including updating original sequences of operation to as-built conditions.
- Provide as-built sequences of operation, control drawings, original set points, and recommended sensor and actuator calibration schedule for systems manual.
- Provide training of the Owner's operating personnel as specified.
- Coordinate with equipment manufacturers to determine requirements to maintain the validity of warranties.

Warranty Period

- Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for issues identified during the warranty period.

2.6.7 TAB Contractor

- Air and water TAB shall be completed with discrepancies and problems resolved before functional testing.

2.6.8 Controls Contractor

The commissioning responsibilities of the controls contractor, during construction and acceptance phases are:

1. Sequences of Operation Submittals.
   The temperature controls submittals shall include complete and detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
   A. A narrative description of the system, describing its purpose, components and function.
   B. Interactions and interlocks with other systems.
   C. Delineation of control interactions between packaged controls and the building automation system, including a listing of monitored points, controlled points, and adjustable points.
   D. Written sequences of control for packaged controlled equipment.
   E. Sequences of control for all modes of operation (Start-up, Warm-up, Cool-down, Normal occupied, Unoccupied, Emergency Shutdown, etc.).

F. Capacity control sequences and equipment staging.
G. Temperature and pressure control sequences (setbacks, resets, etc.).
H. Sequences for all control strategies (economizer control, optimum start/stop, optimization, demand limiting, etc.).
I. Effects of power or equipment failure with all standby component functions.
J. Sequences for alarms and emergency shutdowns.
K. Seasonal operational requirements.

2. Control Drawings Submittal
   A. The control drawings shall have a key to all abbreviations.
   B. The control drawings shall contain graphic schematic depictions of the systems and each component.
   C. The schematics will include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   D. Provide a full points list with at least the following included for each point:
      - Controlled system
      - Point abbreviation
      - Point description
      - Point type (digital/analog, input/output)
      - Display unit
      - Control point or set-point (Yes / No)
      - Monitoring point (Yes / No)
      - Intermediate point (Yes / No)
      - Calculated point (Yes / No)
3. An as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing.

2.6.9 Equipment Suppliers

The commissioning responsibilities of the equipment suppliers are the following:

- Provide requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in effect.
- Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- Provide start-up instructions or reports to the MC or the EC.

3 COMMISSIONING PROCESS

This section sequentially details the commissioning process by commissioning task or activity. A summary of the deliverables is provided below however each section below will explain each step and deliverable in greater detail.

- Commissioning (Cx) Plan (this document, includes OPR & BOD)
- Pre-Functional Checklists (PFC)
- Functional Performance Test (FPT)
- Commissioning Issues Log
- Commissioning Report
- Systems Manual

3.1 Prepare Commissioning Plan

The Commissioning Plan describes the implementation of the commissioning process and provides a framework for integration of commissioning activities into the construction and acceptance process. The Commissioning Plan also provides an agenda for organizing and focusing the commissioning scoping meeting. The Commissioning Plan expands to incorporate more information as the design, construction, and acceptance and warranty phases of the facility are completed. The Commissioning Plan will be updated during the construction and warranty phases.

The Commissioning Plan will include, at a minimum, the following information:

- A brief overview of the commissioning process.
- A list of all commissioned features and systems.
- Identification of the commissioning team and its responsibilities.
- A description of the management, communication, and reporting of the commissioning process.
- An outline of the commissioning scope, including: development of the owner's project requirements, review of the basis of design, schematic design, construction documents, construction phase verification, functional performance test development and implementation and post acceptance activities.
- A list of the expected work products.
- A list of key commissioning milestones.

3.2 Documentation of Owner's Project Requirements and Basis of Design

A clear Owner's Project Requirements (OPR) is critical to the commissioning process. The OPR defines the benchmark for system performance. It is a detailed explanation of the information developed for the Owner's program, focused on those systems included in the scope of work for commissioning. It will clearly define the functional and indoor environmental quality requirements. The Basis of Design document details the Design Team's response to the performance criteria in the Owner's program and OPR report. It will include the heating, ventilation, and air-conditioning requirements for each occupancy type, with references to applicable codes and standards, and other design criteria used as the "basis of design" for other building systems to be commissioned. NORESCO will request these documents from the Owner and Design Team and will review

them for completeness and for future reference as they are integral to the project delivery process, or as required, assist the Design Team to create the necessary deign intent and basis of design reports.

3.3 Develop Commissioning Specifications

Commissioning specifications for the targeted building systems will be prepared by the Owner with assistance from NORESCO, or can be provided by NORESCO if needed. In addition to the distinct Commissioning Specifications, NORESCO will also review the Training, Close Out Documents, and O&M specifications. The proposed specifications will be reviewed for completeness and adequacy relative to defining the commissioning requirements of the general contractor and all installing subcontractors. The commissioning specifications describe the scope and requirements for commissioning, as well as the roles and responsibilities of the general contractor, installing subcontractors, Owner personnel, Design Team, and the NORESCO Commissioning Team. The Training, Close-Out Documents, and O&M specifications support the Commissioning specifications by defining requirements of the Owner's turn over requirements.

3.4 Commissioning Scoping Meeting/Kickoff Meeting

NORESCO will hold a scoping/kickoff meeting after construction is underway which will bring together all members of the design and construction team that will be involved in the commissioning process. Each building energy system to be commissioned will be addressed, including its intended operation, commissioning requirements, and completion and start-up schedules. During the meeting, all parties agree on the scope of work, tasks, schedules, deliverables, and responsibilities for implementation of the Commissioning Plan.

During this meeting, the GC will advise the contractors of their roles in this process, and will explain what tasks and milestones have been added to the "standard" construction process as a result of the Owner including commissioning in their scope. The GC will direct the contractors to the Cx specification and will clear up any questions that may arise as a result of the specification. It is expected that the GC will be prepared and will be familiar with the commissioning specification and its requirements, and will be able to clearly explain what the contractors need to do to participate.

This meeting will be scheduled by the Owner, GC and CxA and should occur prior to the installation of piping and ductwork.

3.5 Commissioning Plan (Cx Plan)

NORESCO finalizes the draft Cx Plan using the information gathered from the scoping meeting. The initial commissioning schedule is also developed along with a detailed timeline. The timeline is fine-tuned as construction progresses. The GC is requested to update NORESCO regularly with construction schedules, and to include Pre-Functional checkout and functional performance testing in the master schedule.

3.6 Submittals Review

The GC will provide NORESCO with a set of equipment and system submittals. NORESCO will review the submittals for completeness and check that the submitted equipment meets the OPR and BOD. This equipment data includes installation and start-up procedures, O&M data, performance data and temperature control drawings. The GC, Subs, or A/E notify NORESCO of any new Basis of Design or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems.

NORESCO review comments will get forwarded to the design engineer of record for that particular system. The design engineer then determines which comments are to be forwarded to the GC and contractor and also determines if the review comment requires re-submittal or not.Page

3.7 Jobsite Observations

Onsite observations are conducted as needed to verify compliance with manufacturer's installation and start-up instructions and recommendations, compliance with the Basis of Design, and meeting the requirements for efficient operation and maintenance. Testing and balancing (TAB) observation will verify TAB methods and procedures on both air-side and water-side systems. Commissioning will also include verification of the TAB as a prerequisite to substantial completion. The verification procedure will spot check (10% sampling rate) air and water flow rates at locations selected by the commissioning engineer. For this activity the TAB contractor will complete the measurements and provide the same instrument that was used when the original data was collected. Construction observation is not for the express purpose of ensuring compliance with codes and standards.

3.8 Pre-Functional Checklists

A Pre-Functional Inspection Checklist will be developed by NORESCO and be completed by the appropriate sub-contractor for all major equipment and systems being commissioned. The checklist confirms the as-built status of the equipment or system and ensures that the systems are complete and operational, so that the functional performance testing can be scheduled. An Owner provided cover page template will be provided for incorporation or addition to the NORESCO checklist. Manufacturer's start-up checklists and other technical documentation guidelines will be used as the basis for all pre-functional checklists. The checklists will be updated as required during the project development or new checklists will be generated if new equipment is added (major equipment additions, are subject to a fee increase).

NORESCO will review and verify the completed Pre-Functional Inspection Checklists before beginning the functional performance testing. Spot checks of equipment for onsite verification will be performed. In addition, NORESCO will be present for the major on-site manufacturer's equipment start-up. NORESCO will review sensor calibration and point-to-point checkout conducted by controls contractor to determine system readiness for TAB and FPT. These activities will be coordinated with the design mechanical and electrical engineers' punch list activities.

3.9 Functional Performance Testing

Functional performance testing verifies the intended operation of individual components and system interactions under various conditions and modes of operation. Functional Performance Testing Plans will be prepared by NORESCO so that the complete sequence of operations is included in the test procedures. The Tests will be updated as required during the project development or new Tests will be generated if new equipment is added (major equipment additions, are subject to a fee increase).

Under the supervision of NORESCO commissioning staff, the installing subcontractor performs the hardware and/or software manipulations required for the testing. NORESCO commissioning staff witness and record the results of functional performance testing. If a building component or system substantially fails the functional performance testing, the installing subcontractor is responsible for making the necessary system adjustments or alterations. The failed component or system will then be re-tested for conformance. It is critical that final start-up procedures, tune-up testing, air and water balancing, and control software de-bugging be complete before any functional performance testing is undertaken.

Testing, adjusting and balancing (TAB) observation will also be performed to verify TAB methods and procedures on both air-side and water-side systems. It is preferred that the TAB contractor will complete the measurements and provide the equipment, however NORESCO will provide that scope if necessary.

3.10 Deficiency Log and Resolution Record

NORESCO will make periodic site visits to witness equipment and system installations. Each site visit will have a specific agenda and will be coordinated with the GC site supervisor. NORESCO attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning. The GC provides NORESCO with information regarding substitutions or change orders that may affect commissioned equipment or the commissioning schedule.

All deficiencies found from site visits and functional performance testing will be documented in a Deficiency Report. The report will include all details of the components or systems found to be non-compliant with the parameters of the functional performance test plans and design documents. The deficiency report will become part of the punch list. The report will detail the adjustments or alterations required to correct the system operation, and identify the responsible party. The deficiency report will be continuously updated. NORESCO schedules any required re-testing through the GC. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between NORESCO, sub-contractor and the GC.

3.11 Operational Maintenance Manuals

Manuals: The operation and maintenance manuals prepared by the contractors for the owner's maintenance personnel are reviewed for completeness. The contractors are encouraged to submit O&M manuals at the earliest possible date. Materials may be added, or requested from the contractors, to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The Operation's Manual will be reviewed and approved by the Architectural Engineering firm representative.

Training: Effective maintenance personnel's training is critical to the long term performance of the new building. NORESCO will assist the owner and GC in organizing the training sessions by identifying the appropriate staff for each session and creating an overall training plan.

For each training session, the contractors provide a detailed agenda for each piece of equipment or system for which training is required. The agenda describes the training scope, duration, and methods, along with the name and qualifications of the trainers. The trainer documents each training session (duration, general subjects covered, and attendees). NORESCO may witness any of the training sessions at their discretion, but is not required to be present for all training. The Training deliverables as documented by the CxA will be reviewed and approved by the Owner's Representative.

3.12 Final Commissioning Report

Final Commissioning Report: A final Commissioning Report will be compiled which summarizes all of the tasks, findings, and documentation of the commissioning process. The report will address the actual performance of the building systems in reference to the design documents. All test reports by various sub-contractors, manufacturers and controlling authorities will be incorporated into the final report.

The commissioning report includes:

- An evaluation of the operating condition of the systems at the time of functional test completion,
- Deficiencies that were discovered and the measures taken to correct them,
- Functional test procedures and results,

- Reports that document all commissioning field activities as they progressed, and
- A description and estimated schedule of required deferred testing.

3.13 An evaluation of the operating Systems Manual

A Systems Manual will be prepared by NORESCO and will include all information required to effectively maintain the building at optimal performance. The Systems Manual will be reviewed and approved by the Owner's Representative. The Systems Manual will include, at a minimum, the following information:

- Final version of the Owner's Project Requirements and Basis of Design
- As-built sequences of operations for all equipment as provided by the design professionals and contractors, including time-of-day schedules and schedule frequency, and detailed point listings with ranges and initial setpoints
- Ongoing operation instructions for all energy- and water-saving features and strategies
- Operating instructions for integrated building systems
- Functional performance test results, blank test forms, and recommended schedule for ongoing benchmarking
- Recommendations for recalibration frequency of sensors and actuators by type and use
- Guidelines for continuous maintenance of the Owner's Project Requirements (operational requirements) and Basis of Design (basis of operation)

4 SCHEDULE

4.1 General Issues

The following sequential priorities are followed:

1. The scheduling of commissioning activities will be coordinated to coincide with the completion of HVAC systems. Commissioning activities that address the interaction between systems will occur upon completion of all HVAC related construction.
2. Equipment is not to be "temporarily" started (for heating or cooling), until pre-start checklist items and all manufacturers' pre-start procedures are completed, code review has been completed, and moisture, dust and other environmental and building integrity issues have been addressed.
3. Manufacturer's startup procedures will be followed and documented on manufacturer provided documentation. This information will be turned over to the GC with the pre-functional checklists. Startup of equipment should be done by a manufacturer's startup technician, not a third party company.
4. HVAC and Lighting Cx: The controls system and equipment it controls are not functionally tested until all points have been calibrated and pre-functional checklists are completed. Functional Performance testing occurs only when the systems being tested are ready to be turned-over to the owner. Functional performance testing does not begin until pre-functional, start-up and TAB is completed for a given system. This activity does not begin for a system until all systems that impact the one planned for testing are complete and operational and ready to be turned-over to the owner.
5. For HVAC systems: The functional performance tests will involve the general contractor, mechanical contractor, TAB contractor, controls contractor, and maintenance personnel. The mechanical engineer is encouraged to attend to verify the systems meet the design and to provide quick resolution to questions that arise. Facilities personnel are encouraged to attend for training purposes.
6. Lighting Cx: The installing contractor holds responsibility for sensor tuning and adjustment, as well as circuit and controls checkout and lighting control system scheduling and/or coordination with controls contractor. When all of this is complete, the functional testing of this equipment can be scheduled.

4.2 Activity Schedule

Table 4-1: Activity Schedule

Activity	Potential Start Date	Activity Duration
Review Owner's Project Requirements (OPR) and Basis of Design (BOD) Review	TBD	2 weeks
Commissioning Specifications	TBD	1 week
Cx Scoping Meeting with MC, CC, EC & GC	TBD	1 week
Final Commissioning Plan Draft	TBD	1 week
Submittal Reviews	TBD	6 weeks
Commissioning Kickoff Meeting	TBD	1 day
Commissioning Jobsite Observations	TBD	1 day
Pre-functional Test Development	TBD	1 week
Functional Performance Test Development	TBD	1 week
Pre-Functional Checklists Filled-out by Installing Contractors	TBD	1 week
Controls Point-to-point checkout	TBD	1 week
HVAC Equipment Startup	TBD	2 weeks
Contractor Controls Sequence programming checkout	TBD	2 weeks
Contractor Lighting control checkout	TBD	2 weeks
Test Adjust and Balance	TBD	1 week
Completed Pre-Functional Test Plans, TAB Report & Equipment Start-up Reports	TBD	**Milestone**
Functional Performance Testing HVAC and Plumbing	TBD	1 week
Functional Performance Testing Lighting Controls	TBD	1 week
Resolution of Issues Log	TBD	2 weeks
O&M Manual Reviews	TBD	2 weeks
Systems Manual	TBD	1 week
Equipment Training	TBD	1 week
Substantial Completion	TBD	**Milestone**
Final Commissioning Report	TBD	2 weeks

APPENDIX B
Executed Functional Checklists

NORESCO

Oct. 1, 2020

Project	St. Mary Basilica	Equip Tag/ID	AHU-1
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	(N/A)			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	(N/A)			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	(Y)	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	(Y)	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	(N/A)			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: 53 Unit: —	Y	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) Measured: 73.6 Stat: 74	Y	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 72 °F	Y	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 42.5 Stat: —	Y	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: —	Y	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	
Procedure	Functional Performance Test	Area Served:	AHU-1
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A			
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		53°F	
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A			
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	(Y)	N	INC	N/A			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		91F	
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	(Y)	N	INC	N/A			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	Y	N	INC	(N/A)			

2.25 sq ft inlet AVG 970 ft/m

2,182 cfm

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU-1
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

Notes:
ZL: Kyle, Lidija, Richard
Roberts Air: Steve

FORM COMPLETED BY:	
PRINT NAME: Eric Granhaug	INITIAL: EG
COMPANY: NORESCO	

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU-2
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	N/A			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	N/A			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	Y	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	Y	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	N/A			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: 55 Unit: —	Y	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) Measured: 76 Stat: 75	Y	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 75 °F	Y	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 42.5 Stat: —	Y	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: —	Y	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

Zone 74.7
42.5

inlet ~~outlet~~ 18" x 18" AVG 613
1.5' 1.5'
=2.25 sf

1379 cfm
vs
1600 cfm per duct

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU-2
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A		55°F	
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A			
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A			
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A			
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	(Y)	N	INC	N/A			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		92°F	
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	(Y)	N	INC	N/A			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	Y	N	INC	N/A			

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

Project	St. Mary Basilica	Equip Tag/ID	AHU 2
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

Notes:
Thermostat heat did not come on until Emergency heat was activated
ZLG: Kyle, Lidija, Richard Roberts Air: Steve
FORM COMPLETED BY:
PRINT NAME: Eric Granberg — INITIAL: EG
COMPANY: NORESCO

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU-3
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	(N/A)			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	(N/A)			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	(Y)	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	(Y)	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	(N/A)			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: 55 Unit: —	(Y)	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) Measured: 75 Stat: 75	(Y)	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 75 °F	(Y)	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 42 Stat: —	(Y)	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: —	(Y)	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU-3
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A			
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A			
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A		55	
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	(Y)	N	INC	N/A			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		109°F	
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	(Y)	N	INC	N/A			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	(Y)	N	INC	N/A			

2.25 qt. AVG 885 cfm/ton

1,991.25 cfm

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

Project	St. Mary Basilica	**Equip Tag/ID**	AHU 3
Procedure	Functional Performance Test	**Area Served:**	
Equipment	Air Handling Unit		

Notes:
ZG: Kyle, Lidija, Richard
Roberts Air: Steve

FORM COMPLETED BY:		
PRINT NAME: Eric Granhaug		INITIAL: EG
COMPANY: Noresco		

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU4
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	(N/A)			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	(N/A)			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	(Y)	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	(Y)	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	(N/A)			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: ~~68~~ 55 Unit: ~~°F~~ ✓	Y	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) 68 Measured: ~~68~~ Stat: 70	Y	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 72 °F	Y	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 42.5 Stat: ✓	Y	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: ✓	Y	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

47.5" x 19.5"
= 6.43 sq ft
AVG 605 ft/min
= 3,890 CFM

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU -4
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A			
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		55F	
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A			
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	(Y)	N	INC	N/A			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		90F	
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	(Y)	N	INC	N/A			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	Y	N	INC	(N/A)			

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

Project	St. Mary Basilica	Equip Tag/ID	AHU 4
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

Notes:
Note: Bad contactor on heating side. Had to be replaced.
Zlo: Kyle, Lidija, Richard Roberts Arc: Steve
FORM COMPLETED BY:
PRINT NAME: Eric Granberg — INITIAL:
COMPANY: NORESCO

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU 5 & 6
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	(N/A)			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	(N/A)			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	(Y)	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	(Y)	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	(N/A)			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: 72 Unit: 72	(Y)	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) Measured: 72 Stat: 72	(Y)	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 72 °F	(Y)	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 52 Stat: —	(Y)	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: —	(Y)	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

#5 55.5" x 30.5"
4.625
2.54
11.75 sq ft
525 ft/min
6,1168 CFM

#6 55".5 x 30.5"
AVG 506 ft/mm
5,945 CFM

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NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU 5 & 6
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A		91F	
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A			
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A			
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	(Y)	N	INC	N/A			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A		90°	
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	(Y)	N	INC	N/A			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	(Y)	N	INC	N/A			

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	AHU 5 & 6
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

Notes:
ZG: Kyle, Lidija, Richard Roberts Air: Steve

FORM COMPLETED BY:	
PRINT NAME: Eric Granhaug	INITIAL:
COMPANY: NORESCO	

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

NORESCO

Project	St. Mary Basilica	Equip Tag/ID	DOAS
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	Pre-Functional Check Documentation	YES	NO	In-complete	N/A			
1.	Has the Pre-Functional Check (PFC) sheet been completed and submitted for review for the Split System (SS)? Have any issues identified during the installation verification been resolved?	Y	N	INC	(N/A)			
2.	Has the balancer submitted a report indicating the SS' air flows have been properly adjusted?	Y	N	INC	(N/A)			
3.	Has the SS manufacturer submitted a start-up report indicating the SS has been started and approved for normal operation? Startup reports have been submitted for review?	(Y)	N	INC	N/A			
4.	Cooling condensate draining properly from drain pan and through trap? Check for no pooling of water in drain pan.	(Y)	N	INC	N/A			
5.	Have Trends been provided showing stable temperature and Humidity conditions?	Y	N	INC	(N/A)			
	Sensor Calibration							
6.	Verify the following sensors are in proper calibration:							
	a. Supply Air Temperature Measured: 55 Unit: _____	Y	N	INC	N/A			
	b. Zone Temperature (ZN-T 1) Measured: 72 Stat: 72	Y	N	INC	N/A			
	c. Record Zone Temperature (ZN-T) set point Set point: 72 °F	Y	N	INC	N/A			
	d. Zone Humidity (ZN-RH) Measured: 42 Stat: —	Y	N	INC	N/A			
	e. Zone Humidity (ZN-RH) set point Set point: —	Y	N	INC	N/A			
	Sequence of Operation							
	System Start:							
7.	Index the unit to start.							
	a. The unit controller commands the supply fan to start.	(Y)	N	INC	N/A			
	b. Condenser Unit starts upon activation of AHU.							
	System Stop:							
8.	Index the unit to stop.							
	a. Supply fan shall ramp down to minimum speed and after time delay unit indexed "OFF".	(Y)	N	INC	N/A			
	b. Condenser Unit shuts down.							

243 ft/min
× 3 sq ft @ 40%
729 CFM

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NORESCO

Project	St. Mary Basilica	Equip Tag/ID	DOAS
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

#	Functional Performance Test Procedure	Result				Initial	Date	Notes
	System Temperature Control:							
9.	Lower the space temperature set point below the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the cooling sequence by enabling the cooling stage?	(Y)	N	INC	N/A			
	b. Are additional cooling stages enabled as required to maintain the new space temperature set point?	(Y)	N	INC	N/A			
	c. Does the unit controller disable the cooling sequence once the space temperature has met the new set point?	(Y)	N	INC	N/A			
10.	Raise the space temperature set point above the current space temperature	Y	N	INC	N/A			
	a. Does the unit controller start the heating sequence?	Y	N	INC	(N/A)			
	b. Are additional heating stages enabled as required to maintain the new space temperature set point?	Y	N	INC	(N/A)			No Heating
	c. Does the unit controller disable the heat once the space temperature has met the new set point?	Y	N	INC	(N/A)			
	Dehumidification							Optional
11.	Lower the relative humidity set point to 10% below current set point.							
	a. Does the unit controller start the dehumidification sequence?	Y	N	INC	(N/A)			
	b. Does the unit controller start the hot gas reheat coil?	Y	N	INC	(N/A)			
	c. Record cooling coil temp. _____ °F	Y	N	INC	(N/A)			
	a. Record reheat coil temp. _____ °F	Y	N	INC	(N/A)			
12.	Raise the relative humidity set point above the zone humidity set point.							
	a. Does the unit controller disable the dehumidification sequence?	Y	N	INC	(N/A)			
13.	Return relative humidity set point back to the original value	Y	N	INC	(N/A)			
	Safeties							
14.	On activation of a safety control, the system stop sequence will occur as described, except fan shutdown will be initiated with no time delay.	Y	N	INC	(N/A)			
15.	Simulate fan failure condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
16.	Simulate static exceeding high limit condition, does the safety stop sequence occur and an alarm issued at the unit controller?	Y	N	INC	(N/A)			
	Operating Setpoints							
17.	Verify all setpoints match the attached sequence of operation provided by Emerson Climate Technologies	(Y)	N	INC	N/A			

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

Project	St. Mary Basilica	Equip Tag/ID	DOAS
Procedure	Functional Performance Test	Area Served:	
Equipment	Air Handling Unit		

Notes:
EG: Kyle, Lidija, Richard
Roberts Air: Steve

FORM COMPLETED BY:	
PRINT NAME: Eric Granhaug	INITIAL:
COMPANY: NORESCO	

If a conflict exists between the installation check sheet and prevailing construction documents, the construction documents will take precedence over the check sheet. If a response to an item is "N," the issue will require explanation in the 'Note' section and may imply that an Issue has been generated.

APPENDIX C
Identified Issues - Updated

Commissioning Issues Database Template

Issue #	Field Engineer	Location:	Equipment Type:	Equipment Tag:	Date Found:	Activity	Issue:	Reason for issue	NORESCO Recommended Corrective Action:	Responsible Party / Sub	Response / Corrective action details	Issue Status	Issue Close Date
1	EJG	Church	Split AC Unit	AHU2	10/1/20	FPT	Heat mode could not be activated during FPT activities.	Heat mode was locked out in thermostat.	Investigate and resolve heating mode issue.	Mech	Steve with Roberts air was able to trouble shoot the issue on site and resolve the issue.	Closed	10/1/20
2	EJG	Church	Split AC Unit	AHU4	10/1/20	FPT	Heating mode on AHU could not be activated during FPT activities.	Unknown	Investigate and resolve heating mode issue.	Mech	Steve with Roberts Air investigated and found a bad contactor on the heating side of the unit. Steve was able to replace and resolve the issue while on site.	Closed	10/1/20
3	EJG	Church	Split AC Unit	AHU1	10/1/20	FPT	Unit could not be turned on via the thermostat.	Thermostat was locked out.	Investigate and unlock thermostat.	Mech	Steve with Roberts Air was able to resolve the issue while on site and the unit was able to be tested.	Closed	10/1/20
4	EJG	Church	Split AC Unit	AHU1 & AHU2	7/30/21	Warr.	Cooling DAT too low. Condensate forming on unit.	TBD: Suspect low charge	Service units to determine cause of low cooling DAT.	Mech			
5	EJG	Church	Split AC Unit	AHU3	7/30/21	Warr.	Unit not functional	TBD	Repair unit to restore functionality and re-test.	Mech			
6	EJG	Church	Split AC Unit	AHU4/5/6	7/30/21	Warr.	High DAT during cooling.	TBD: Suspect contactor or charge issue.	Investigate/service units to determine why the DAT is high on cooling.	Mech			
7	EJG	Church	Split AC Unit	AHU4/5/6	7/30/21	Warr.	Low DAT during cooling	TBD	Investigate AHU's to determine why heating DAT is low.	Mech			
8	EJG	Church	Split AC Unit		7/30/21	Warr.							