

**Brookhaven National Laboratory
National Synchrotron Light Source II**
Upton, New York



**Construction Phase
Commissioning Plan**

November 14, 2008
revised March 25, 2009



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COMMISSIONING PLAN APPROVAL

This Commissioning Plan serves as a guide to the commissioning of facilities, utilities and equipment for the NSLS II project. The purpose of this Commissioning Plan Approval page is to indicate that the members of the Commissioning Team have reviewed and accepted the information contained herein for use on the above mentioned project.

WRITTEN BY	DATE
Michael Gannon BVH Integrated Services, Inc.	
Printed Name	
Signature	
APPROVED BY	DATE
Stephen Sawch Brookhaven National Laboratory	
Printed Name	
Signature	
APPROVED BY	DATE
Alan Walker HDR, Inc.	
Printed Name	
Signature	
APPROVED BY	DATE
Scott Loureiro Torcon, Inc.	
Printed Name	
Signature	

REVISION HISTORY

Revision A will be released for use as a planning tool with open issues if necessary. As more information becomes available, interim revisions (B, C) will be issued as necessary. After all open issues have been resolved; Revision 0 will be issued for approval. Following approval, revisions will be traced with the next sequential integer (1, 2). Following formal approval of Revision 0, each subsequent revision will require formal approval.

DOCUMENT REVISION HISTORY			
Revision	Date	Description	Prepared By
A	11/14/08	Preliminary Construction Phase Cx Plan, for review	MJG
B	3/25/09	Construction Phase Cx Plan, for review	MJG

COMMISSIONING TEAM

The Commissioning Team will consist of committed representatives of the Owner, Design Team and individual Trade Contractors. The following table identifies each member of the Commissioning Team as well as their affiliation with the project and a brief overview of their responsibilities during the commissioning process. The cooperation and participation required of the individuals listed below is essential in order to successfully complete the commissioning process.

Team Member	Company	Role	E-Mail	Responsibility
Michael Gannon	BVH Integrated Services, Inc.	Commissioning Authority	MikeG@BVHis.com	Implement and direct commissioning process, functionally test building systems, provide summary report.
Steve Sawch	BNL NSLS II	Owner – Project Manager	Sawch@bnl.gov	Ensure owner related issues are addressed in a timely manner to facilitate project completion.
Alan Walker	HDR Inc.	Designer – Architect / Engineer	Alan.Walker@hdrinc.com	Develop BOD based on OPR and existing conditions. Include all aspects of commissioning in contract docs.
TBD		Owner - Facilities Management		Provide staff or assist in commissioning activities as schedule allows.
Scott Loureiro	Torcon, Inc.	General Contractor	sloureiro@torcon.com	Ensure commissioning is integrated into construction process, including schedule.
TBD		Mechanical Contractor		Comply with commissioning plan and make sure all subs are aware of requirements.
TBD		Electrical Contractor		Comply with commissioning plan and make sure all subs are aware of requirements.
TBD		Plumbing Contractor		Comply with commissioning plan and make sure all subs are aware of requirements.

Team Member	Company	Role	E-Mail	Responsibility
TBD		Temperature Control Contractor		Assist in development of, and take part in, specific commissioning procedures.
TBD		Test and Balance Contractor		Assist in development of, and take part in, specific commissioning procedures.

OVERVIEW

The National Synchrotron Light Source II (NSLS II) facility, located on the campus of Brookhaven National Laboratory in Upton, New York is a newly constructed state-of-the-art research facility. The building and associated structures will contain approximately 333,000 gross square feet.

The intent of commissioning the NSLS II facility is to make every effort to insure that the environmental quality of the facility is acceptable and satisfies the design parameters, prior to its occupancy. Additional goals of commissioning are to provide documented confirmation that a facility fulfills the performance requirements of the building Owner, occupants, and operators. This is accomplished by providing quality assurance of the installation and functionality of the building systems and equipment. With this in mind, Brookhaven National Laboratory has retained the services of BVH Integrated Services, Inc. to act as the Commissioning Authority (CA) on this project.

The term commissioning refers to the comprehensive evaluation of a building project to ensure that the finished facility operates within the guidelines and parameters dictated by the Owner's Project Requirements. The intended physical and architectural characteristics of a given space, the number of occupants and the types of activities that take place within it have a direct impact on how the control systems of that space operate. Modern buildings include various control systems capable of controlling environmental properties such as space conditioning, lighting, and noise level. The facility's environmental quality is directly related to how well the aforementioned fields interact with one another.

As the Commissioning Authority, BVH Integrated Services will supervise and oversee the commissioning process. This process is best described as a systematic verification to determine that each individual system functions as intended. In addition to this work, the Commissioning Agent will develop and utilize functional test procedures that will be used to verify and document the performance of those systems being commissioned. If there are deficiencies identified within a particular system during the commissioning process, then the Commissioning Authority will facilitate discussions with the Owner, General Contractor, and the Design Team. Dependent on the outcome of these discussions, the Owner will finalize their decisions on how they will proceed in bringing the systems to an acceptable standard.

This Commissioning Plan has been developed by BVH Integrated Services, Inc. to act as an informational document to clarify how the commissioning process shall proceed. This plan will outline the responsibilities of the Commissioning Authority, Owner, Design Team, and Contractors.

This project is also slated to be a LEED Certified Project. (NCv2.2) The Leadership in Energy and Environmental Design (LEED) program requires building commissioning as part of the certification process. The minimum commissioning-related requirements include verification and ensuring that fundamental building elements and systems are

designed, installed and calibrated to operate as intended. The project Owner is required to implement or have a contract in place to implement the following fundamental best practice commissioning procedures.

- Engage a commissioning team that does not include individuals directly responsible for project design or construction management.
- Review the design intent and the basis of design documentation.
- Incorporate commissioning requirements into the construction documents.
- Develop and utilize a commissioning plan.
- Verify installation, functional performance, training and operation and maintenance documentation.
- Complete a commissioning report.

The Owner then needs to provide the LEED Letter Template, signed by the Owner or commissioning agent, confirming that the fundamental commissioning requirements have been successfully executed or will be provided under existing contract; engage a commissioning authority and adopt a commissioning plan; include commissioning requirements in bid documents and task the commissioning agent to produce a commissioning report once commissioning activities are completed.

To qualify for the additional commissioning credit towards LEED certification, (EA Credit #3) the Owner must verify and ensure that the entire building is designed, constructed and calibrated to operate as intended. In addition to the Fundamental Building Commissioning prerequisite, the Owner must implement or have a contract in place to implement the following additional commissioning tasks:

- A commissioning authority independent of the design team shall conduct, at a minimum, one commissioning design review of the Owner's Project. Requirements, Basis of Design, and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submissions.
- An independent commissioning authority shall review the contractor submittals relative to systems being commissioned.
- Develop a systems manual that will provide future operating staff the information needed to understand and optimally operate the commissioned systems.
- Verify that the requirements for training operating personnel and building occupants are completed.
- Conduct a review of the building systems / operations within 10 months after substantial completion with the O&M staff and occupants.

The Owner then needs to provide the LEED Letter Template, signed by the Owner or independent commissioning agent as appropriate, confirming that the required additional commissioning tasks have been successfully executed or will be provided under an existing contract.

PROCESS

The Commissioning Authority has developed this Construction Phase Commissioning Plan which outlines the responsibilities and procedures that will be used throughout the duration of the commissioning process. The plan identifies which systems are to be commissioned and provides an overview of the methods of verification and documentation that will be utilized by the Commissioning Authority. Preliminary schedules for the functional testing of the systems will be outlined. This preliminary Commissioning Plan will be reviewed by the Owner. After approval of the Commissioning Plan, the Commissioning Authority will be responsible for presenting and reviewing it with the Commissioning Team. This Commissioning Plan will be updated to more accurately reflect the specific requirements of this project as the job progresses. The members of the Commissioning Team will participate in the commissioning process as outlined below.

Controls Review

The Commissioning Authority will perform a review of the designed control systems strategy. The intent of the review is to verify that the strategy will meet the Owner's project requirements and the needs of commissioning process, i.e., functional performance testing. The Commissioning Authority will also review the controls specifications to assure that all necessary requirements for coordination with the Testing, Adjusting, and Balancing Subcontractor are included.

Controls Checkout Plan

As detailed in specification section 15970, 3.5 D, the Controls Subcontractor will provide a detailed testing and procedures plan for approval. This plan should detail the process for verification of point-to-point wiring, sensor calibration, controller check out, etc. The controls subcontractor will coordinate the start up and testing of the temperature controls with the mechanical equipment start up. The Controls Subcontractor will coordinate with the Testing, Adjusting and Balancing (TAB) Subcontractor to ensure that appropriate control equipment is available for use and training has been provided to the TAB Subcontractor for completion of the TAB work.

Testing, Adjusting and Balancing

The TAB Subcontractor will develop and submit a TAB Strategies and Procedures Plan per 15990, 1.7 A, including a description of how the control system will be used during the TAB execution, for review and comment as required by the applicable specification section. The Commissioning Authority will review the plan concurrently with the Engineer for effectiveness and coordination and may provide comments on the plan. The Commissioning Authority does not approve the plan. The Controls Subcontractor shall also review the plan for feasibility of use of the controls system.

TAB work must be performed after the controls system has been completed and all checkout and startup documentation has been completed by the Controls Subcontractor to assure accurate testing, adjusting and balancing. The Commissioning Authority will

verify the air and water balancing by spot checking systems, reviewing completed balancing reports and through selected site observation.

Functional Testing

The Commissioning Authority will coordinate, supervise and participate in the functional performance testing (FPT) of the building systems and equipment. This testing will be done in accordance with the approved functional test procedures and the results will be recorded on the functional test sheets provided by the Commissioning Authority. The Contractors will provide trained technicians that have participated in the installation of the systems and equipment being tested to assist in the functional testing process. The Owner will also provide operational staff to participate in the functional testing.

The Commissioning Authority provides a sample FPT in the Appendix of the plan and develops FPT procedures in a sequential written form, coordinates, oversees and documents the actual testing. Conditional variations such as emergency modes and opposite seasonal testing are identified in the FPTs. Some FPTs may include DDC trend logging to confirm system operation.

When a piece of equipment or system has been verified by the Contractors as ready for testing, they will notify the Commissioning Authority and that piece of equipment and/or system will be examined for commissioning readiness. Once deemed complete, the functional testing will commence.

If the system appears not ready for testing or fails during the testing process, the Commissioning Authority will update the BVH Commissioning Portal and notify the Contractors and Owner that the Portal has been updated. This update will describe any and all deficiencies and what the recommended action is to correct any problems. If assistance is needed from the Design Team, a request will be incorporated into the updated Portal Commissioning Notice, asking for such recommendations and/or comments from the Design Team. Any review comments shall be updated via the Commissioning Portal. After review and approval, this notice shall be given to the respective Contractors. Once the Contractors have made any necessary corrections, they will update the Commissioning Portal as necessary. Once a corrective item has been completed, the Commissioning Authority shall resume testing this outstanding item.

The Commissioning Authority will keep the Owner, Design team and Contractors informed of the process of this testing by providing a bi-weekly report or Commissioning Notice. If the test results do not comply with the test standards, the Commissioning Authority will facilitate a meeting between the Owner, Design Team and Contractors to resolve the issue. The Commissioning Authority will provide recommendations of what actions should be taken and moderate discussions concerning any outstanding issues. The Owner and Design Team will provide the final decision of what approach will be taken and direct the responsible parties to take corrective action.

If the test fails more than one re-test due to lack of appropriate action by the Contractors, the Commissioning Authority will call a meeting to discuss appropriate resolutions and procedures. The final testing results for each test will be included in the Commissioning Authority's Commissioning Report which will be submitted to the Owner upon completion of the commissioning process.

SCHEDULE

Incorporation of commissioning into the project schedule requires coordination among the commissioning team members.

During construction, it is essential that the flow of information and materials include the Commissioning Authority and that time for CA review and any required revisions be allowed. The Commissioning Authority will work with the lead individuals on overall project scheduling, typically the Architect and Construction Manager, to ensure that the commissioning milestones are included.

Detailed testing and training schedules will be developed by the Commissioning Authority and Construction Manager as construction progresses, establishing sequential priorities to ensure work progresses in a logical manner that supports the commissioning process. Examples of the sequential priorities that will be required for the project include:

- Equipment may not be temporarily started until proper construction startup, checkout and documentation has been performed.
- Functional testing does not begin until construction and startup check-out and TAB have been completed for any given system (this does not preclude a phased approach).
- The controls system and the equipment it controls are not functionally tested until all control points have been calibrated and all related control testing completed.
- The controls system programming has been tested in conjunction with the point-to-point check-out and sensor calibration.

RESPONSIBILITIES

Commissioning Authority

The Commissioning Authority will prepare a Preliminary Commissioning Plan and submit this plan to the Owner for review. The Commissioning Authority will adjust the document based on the Owner's assessment and related comments and submit it for final approval. The Commissioning Authority and the Owner will review the final Commissioning Plan with the Contractors involved. Specific responsibilities vary with the management scenario and the Commissioning Authority's specific scope of services. Ideally, the same party or firm acts as Commissioning Authority through all project phases, as detailed below:

Construction

During construction, the Commissioning Authority is in charge of the commissioning process and makes final recommendations to the Owner about functional performance of commissioned building systems and assemblies. The Commissioning Authority is an advocate for the Owner, acting as independently and objectively as possible. The core commissioning activities during construction are to:

- Review construction submittals
- Observe installations and start-up
- Organize, plan, develop, and execute testing
- Review traditional O&M manuals
- Verify operator training

Post Occupancy

During occupancy and operations, the Commissioning Authority helps resolve commissioning issues and directs opposite-season testing. The CA will participate in a near-warranty-end review of system and assembly performance.

Owner

The Owner will review the Preliminary Commissioning Plan and provide comments to the Commissioning Authority. As required, they will meet with the Commissioning Authority to clarify any changes to the document. The Owner will approve the final document. With the Commissioning Agent, they will review the final Commissioning Plan with the Contractors involved.

Owner's Project Management Staff

The Owner's project management staff's ultimate responsibility is to see that the commissioning plan is executed. The Owner should include commissioning responsibilities in all commissioning team members' scopes of services, make sure there is sufficient time for commissioning in the project schedule, ensure the Commissioning Authority is receiving cooperation from other team members, and ensure that other Owner responsibilities (developing the OPR, having O&M staff participate during

construction) are fulfilled. The Owner ensures that all design review and construction phase issues identified through commissioning are resolved in a timely manner.

Owner's Operations Staff

Pre-design

The Owner's O&M staff should establish the OPR during pre-design.

Design

During design, this staff contributes to reviews of the designer's BOD, plans, and specifications.

Construction

During construction, this staff may:

- Assist in reviewing selected submittals
- Assist in construction observation, verifying completion of construction checklists and observing start-up
- Participate in or witness testing
- Review O&M and systems manual
- Participate in training

Post Occupancy

The Owner's O&M staff's role and responsibilities are:

- Participate in a post occupancy/near end of warranty review with the GC, designer, CA
- Share any warranty or construction related items and cooperate with the Commissioning Authority in executing post occupancy commissioning activities
- Assist in resolving issues identified during the construction process

Design Team

The Design Team will understand the commissioning process as outlined in the Commissioning Plan and provide participation as detailed in the plan or as requested by the Owner.

Design

The design professionals should develop complete basis-of-design (BOD) documentation, including design narratives, rationale, and criteria, according to their scopes of services, and update this document with each new design submission. They provide input to the Commissioning Plan, respond to questions and concerns by the Commissioning Authority and others, respond to design review comments, and incorporate commissioning requirements in construction Contract Documents.

Construction

During construction, Designers:

- Review the commissioning plan
- Attend selected commissioning meetings
- Answer questions about system design and intended operation
- Update design narratives in the BOD to reflect as-built conditions
- Respond to or incorporate CA comments on construction submittals and O&M manuals
- Help resolve design-related issues raised during commissioning
- Perform specified training
- Submit required portions of the Systems Manual

Post Occupancy

The Design Team's role and responsibilities are:

- Participate in a post occupancy/near end of warranty review with the GC, designer, CA
- Assist in providing any corrective solutions to warranty or construction related issues identified, cooperating with the Commissioning Authority in executing post occupancy commissioning activities

Additional tasks sometimes required are to present system description overviews for primary systems during O&M staff training, review and approve testing plans and procedures, review completed test forms, or witness selected tests.

Construction Manager

The Construction Manager's (CM) role shall be to ensure the Contractors are executing their commissioning responsibilities according to the Commissioning Plan and help resolve issues. Throughout the commissioning process, the Commissioning Authority will generate documents containing deficient or outstanding items and share them with the commissioning team. It is important that the Construction Manager obtain all necessary information back from the Subcontractors for communication back to the Commissioning Authority via the on-line tracking database (***BVH Commissioning Portal***). This is necessary to assure proper issue tracking and proper close-out of any outstanding items identified throughout the commissioning process.

Design

The Construction Manager reviews commissioning requirements and performance criteria for coordination, schedule, and cost implications.

Construction

The Construction Manager's roles and responsibilities are:

- Ensuring Subcontractors' commissioning work is completed and cooperating with the Commissioning Authority in executing the Commissioning Plan
- Providing input into the Commissioning Plan
- Integrating the commissioning schedule into the overall project schedule
- Participating in commissioning meetings
- Responding to questions and issues raised by the Commissioning Authority
- Resolving issues identified during commissioning and coordinating correction of identified deficiencies
- Providing equipment, system and assembly data and information needed by the Commissioning Authority
- Performing specified training
- Submitting required portions of the Systems Manual

Post Occupancy

The Construction Manager's roles and responsibilities are:

- Post occupancy/near end of warranty review with the Owner, Designer, and Commissioning Authority
- Ensuring Subcontractors are responding to warranty items and cooperating with the Commissioning Authority in executing post occupancy commissioning activities
- Resolving issues identified during commissioning and coordinating correction of identified deficiencies

Trade Contractors**Design**

Trade Contractors of specialty or complex systems or designs should review commissioning requirements and performance criteria of their systems for coordination, schedule, and cost implications.

Construction

The responsibilities of the Installing Trade Contractors (and vendors, as appropriate) include:

- Cooperating with the Commissioning Authority (and the Contractor's Commissioning Manager, when applicable) in executing the Commissioning Plan
- Providing input into the Commissioning Plan
- Coordinating with other trades as necessary to facilitate a smooth and complete commissioning process

- Participating in commissioning meetings
- Responding to questions and issues raised by the Commissioning Authority
- Executing and documenting tasks in the construction checklist and start-up process
- Performing and documenting tests when in their scope
- Participating in resolving issues identified during commissioning
- Correcting identified deficiencies and responding to deficiency notices via the on-line tracking database (BVH Commissioning Portal)

Post Occupancy

The responsibilities of the Installing Trade Contractors (and vendors, as appropriate) include:

- Post occupancy / near end of warranty review with the owner, designer, CA
- Ensuring proper response to warranty items and cooperating with the Commissioning Authority in executing post occupancy commissioning activities
- Resolving issues identified during commissioning and correction of identified deficiencies

Commissioning-related activities of Trade Contractors are to prepare O&M manuals and submissions to the systems manual and provide training on commissioned systems and assemblies.

COMMISSIONING DOCUMENTS

In order to gain a complete understanding of the design intent and desired functionality of systems and equipment to be commissioned, the Commissioning Authority requires several documents from the Owner, Design Team and the Contractors. It should be noted that the Commissioning Authority will view the Contract Documents (plan drawings, specifications, etc.) as taking precedence over any other forms of project documentation.

The documents utilized by the Commissioning Authority include but are not limited to:

Owner's Project Requirements (OPR)

- Also referred to as the design intent, the OPR is documentation of a project's functional requirements and expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

Basis of Design (BOD)

- The basis of design is the documented primary decision-making process and assumptions behind design decisions made to meet the OPR. It describes the systems, assemblies, conditions and methods chosen to meet these requirements.

Contract Documents

- Contract Documents include all addenda, trade plan drawings, specifications, sequences of operations, etc., as produced by the Architect and/or Engineer of Record and their consultants to obtain construction bids.

Construction Checklists

- Construction checklists are detailed sheets used by the Commissioning Authority to ensure all equipment is installed per the Contract Documents. These sheets are customized by the Commissioning Authority for the specific piece of equipment or specific system being commissioned.

Submittals

- Equipment submittals and shop drawings are detailed specification sheets and assembly details of the exact equipment to be installed as part of the project. Submittals and shop drawings are produced by the manufacturer, supplier or fabricator of the equipment for review and approval by the Architect or Engineer of Record. The Commissioning Authority also reviews applicable submittals to ensure conformance with the Commissioning Plan.

Change Orders

- Change Orders are changes to the Contract Documents that occur after a project price has been bid or negotiated. Regardless of the cause, Change Orders can change the scope of the project or affect the commissioning requirements of the project or specific systems.

Manufacturer Approved Equipment Start-Up Reports

- Equipment manufacturers possess the most detailed knowledge regarding the equipment they provide. All applicable information provided by manufacturers will be incorporated in the commissioning process.

O&M Manuals and Associated Equipment Manufacturer's Documentation

- Operation and Maintenance (O&M) manuals and Associated Equipment Manufacturers Documentation will be used to generate the construction checklists and is a key component of the training of operations and maintenance personnel.

Commissioning Plan

- This is an overall plan, developed before bidding (Design Phase Commissioning Plan) or after bidding (Construction Phase Commissioning Plan), that provides the structure, schedule, and coordination planning for commissioning. The Commissioning Plan is updated as the project progresses from pre-design, through design and construction.

Prefunctional Checklists

- Prefunctional checklists are detailed sheets created by the Commissioning Authority and used by the Installing Contractors to ensure all important equipment details are included in the installation. These sheets are customized by the Commissioning Authority for the specific piece of equipment or specific system being commissioned.

Functional Performance Test Sheets

- Functional performance test sheets are detailed sheets used by the Commissioning Authority to ensure all important equipment parameters are verified during initial operation of equipment for the commissioning process. These sheets are customized by the Commissioning Authority for the specific piece of equipment or specific system being commissioned.

System Training Manual

- The Systems Training Manual will provide the information needed to understand, operate, and maintain the systems and/or to inform others about the systems. It is to be the repository of all updates and corrections as they occur.

BVH Commissioning Portal

- The BVH Commissioning Portal is an on-line tracking database. The portal is used by the Commissioning Authority to track issues and assign responsibility for corrective action. All members of the Design/Construction/Commissioning Team will be given access to the Commissioning Portal as required to respond to issues or deficiencies.

Commissioning Notices

- The Commissioning Notice is typically a bi-weekly report generated by the Commissioning Authority that identifies the project progress as it relates to building commissioning. The Commissioning Notice is a summary of current issues from the on-line tracking database (BVH Commissioning Portal). The Commissioning Notice is distributed to the Owner, Design Team, and responsible Contractors, when applicable, at commissioning progress meetings. The Commissioning Notice identifies and tracks the corrective action of deficiencies identified by the Commissioning Authority.

Commissioning Reports

- The Commissioning Authority will write and submit a final commissioning report detailing, for each piece of commissioned equipment or assembly, the adequacy of equipment or assemblies meeting the Contract Documents. The following components are typically included:
 - Description of the OPR
 - Description of the project specifications
 - Verification of installation (commissioning notices)
 - Functional performance tests sheets
 - O&M documentation evaluation
 - Training program evaluation
 - Value of the commissioning process
 - Outstanding issues
 - Systems Manual

Noncompliance items will be specifically listed. A brief description of the verification method used (manual testing, trend logs, data loggers, etc.) and observations and conclusions from the testing will be included. The final commissioning report is updated after occupancy/operations phase commissioning.

SYSTEMS TO BE COMMISSIONED

The following list gives a description of the types of systems to be commissioned. The system description is meant to include all support equipment, components and controls. This list was generated based on the request for proposal and design development construction documents. The purpose of this commissioning effort will be to verify and document the operation of the following systems:

1. Hot Water Heating System: Includes any and all of the following equipment: primary & secondary heating pumps, heating coils, heat exchangers, hydronic balancing, variable frequency drives, controls, valves, unit heaters, cabinet unit heaters, electric duct heating coils, steam pressure reducing stations and condensate pumps.
2. Cooling System: Includes any and all of the following equipment: chilled water pumps, cooling towers, condenser water pumps, heat exchangers, hydronic balancing, variable frequency drives, valves and controls associated with the central cooling system.
3. Air Handling Systems: Includes any and all of the following equipment: As a minimum, all of the air-handling units and make up air units will be thoroughly checked for proper operation and control. The units will be verified for their operation as heating, cooling, and ventilation systems, including outdoor air economizer. Unit shut down and start-up under normal and emergency power will be verified. All refrigeration (DX systems) will be verified for proper operation.
4. Supply Air Distribution Systems: 25% of the installed terminal variable air volume fan coils and exhaust air boxes will be tested to provide a thorough evaluation of their operation; all variables will be covered by exposure, occupancy, and critical and sound sensitive areas.
5. Exhaust Fans: 25% of the general exhaust fans will be verified for proper operation and their interaction with total building air balance.
6. All of the smoke exhaust operations will be verified under normal and smoke conditions.
7. All Direct Digital Controls (DDC) shall be verified for proper operation as they relate to the above equipment including interfaces for remote monitoring.
8. All security and system interlocks associated with the control system shall be commissioned.
9. Spot checking of air and water balancing readings including space pressurization.

10. All of the emergency lighting and emergency power transfer switches shall be verified for proper operation and control. Lighting levels shall be recorded and any deficiencies reported.
11. Building domestic hot water heating systems
12. Building elevators
13. Fire Protection System
14. Day lighting controls
15. Occupancy Sensors
16. Fire Alarm
17. Site Lighting and Controls
18. Fire Protection Systems
19. Domestic and process water pumping and mixing systems
20. Domestic water heating including the recirculation line
21. Tepid water systems and emergency shower / eyewash
22. Any sump pumps
23. Compressed air systems
24. Liquid Nitrogen System
25. Gaseous Nitrogen System
26. Building Envelope
27. Electrical Testing – Typically, the job specifications will purchase the following scope of services regarding electrical equipment testing by the Electrical Contractor:
 - Short Circuit Study
 - Protective Device Coordination
 - Load Bank Testing (UPS & Generator)
 - Grounding - Section
 - Generator - Calls for manufacturer start-up requirements
 - Security Systems
 - Data & Communication

It is the intent of our commissioning effort to coordinate and document the testing of the electrical systems only as noted above based on the testing requirements set forth in the contract documents.

COMMISSIONING PHASE PROCESS OVERVIEW

COMMISSIONING DURING CONSTRUCTION

Objectives

Commissioning during construction (also known as the **Acceptance Phase**) should document and verify that:

- All systems and assemblies are provided and installed as specified.
- All systems and assemblies are started and function properly.
- The systems manual is updated and provided to facility staff.
- Facility staff and occupants receive specified training and orientation.

Additional Commissioning Team Tasks

Pre-Functional Verification

A detailed schedule for all commissioning activities, with specific dates consistent with the overall project construction schedule will be developed, with the assistance of the Owner's operations and maintenance personnel, to assist the Construction Manager in scheduling the responsible Subcontractor to assist where necessary.

Functional testing of all applicable systems and subsystems cannot begin until:

- HVAC systems and associated subsystems have been completed, calibrated, and started up and are believed to be operating in accordance with Contract Documents.
- Automatic control systems have been completed and calibrated and are believed to be operating in accordance with the Contract Documents.
- Testing, adjusting, and balancing procedures have been completed, and all TAB reports have been submitted and reviewed and discrepancies corrected and accepted.
- A statement shall be issued certifying that all work has been completed and equipment and systems are operational in accordance with the Contract Documents.

Before the functional testing can start, a list of all equipment and systems involved in the commissioning process shall be developed. This list will be compiled based on Construction Document reviews, shop drawing submittals, and input from the Design Team and Owner.

Based on this list of equipment to be commissioned, pre-start / start-up documentation for all equipment and systems involved in the commissioning process must be provided by the Contractors prior to any functional testing. This documentation must include detailed, step-by-step procedures used in the start-up of equipment and must clearly indicate all manufacturer required checkout procedures and evidence that such

procedures have been thoroughly completed. This documentation shall also clearly state that such equipment has been put through the appropriate season startup process, conducting the functional performance tests on each piece of equipment and system. Provisions for verifying all relevant data, recording the results obtained, and listing the parties involved in each start-up and checkout must be included in the documentation.

Functional Testing

The Commissioning Authority will direct the performance of all functional test procedures. The Commissioning Authority will provide a bi-weekly report or Commissioning Notice of the progress of functional testing via the BVH Commissioning Portal. The Commissioning Authority will provide recommendations and moderate meetings with all parties to discuss solutions to any problems identified during testing. The final testing results for all tests will be included in the Commissioning Authority's Commissioning Report which will be submitted to the Owner upon completion of the Commissioning Process.

The Owner will provide time for their operation's staff to participate in the functional testing under the supervision of the Commissioning Authority. The Owner will review all weekly reports and Commissioning Notices. When required, they will review the functional test reports with the Design Team and direct the Contractors to take corrective action where deemed necessary. As required, the Owner will review with all parties any problems identified during the functional testing process. With the Design Team, the Owner will direct appropriate parties to take corrective action to solve problems identified during the testing process.

If so desired by the Owner, the Design Team will assist the Owner in reviewing the Commissioning Authority's reports. As required, they will review with all parties any issues identified during the functional testing process. With the Owner, the Design Team will direct appropriate parties to take corrective action to solve problems identified during the testing process.

The Contractors will assist the Commissioning Authority in the functional testing by providing the correct personnel when requested by the Commissioning Authority. The Contractors will act in a timely manner to correct any problems described in any of the commissioning reports. The Contractors will document all corrective actions taken as noted on the commissioning reports. The Contractors will participate in discussions with all parties to determine possible solutions to any problems encountered during the functional testing. As directed by the Owner and Design Team, the Contractors will take required actions to correct problems identified during the functional testing process.

POST OCCUPANCY COMMISSIONING

The commissioning team shall perform a post occupancy or near-end-of-warranty review of the project. The Commissioning Authority shall return to the site two months prior to the end of the warranty period. The Commissioning Authority will review current building operation with the facility staff and address the condition of outstanding issues related to the Owner's project.

The Commissioning Authority will also interview facility staff to identify problems or concerns they have in operating the building as originally intended. The Commissioning Authority will provide suggestions for improvements and record these changes in the systems manual. The Commissioning Authority will identify any problems covered under the warranty or under the original construction contract.

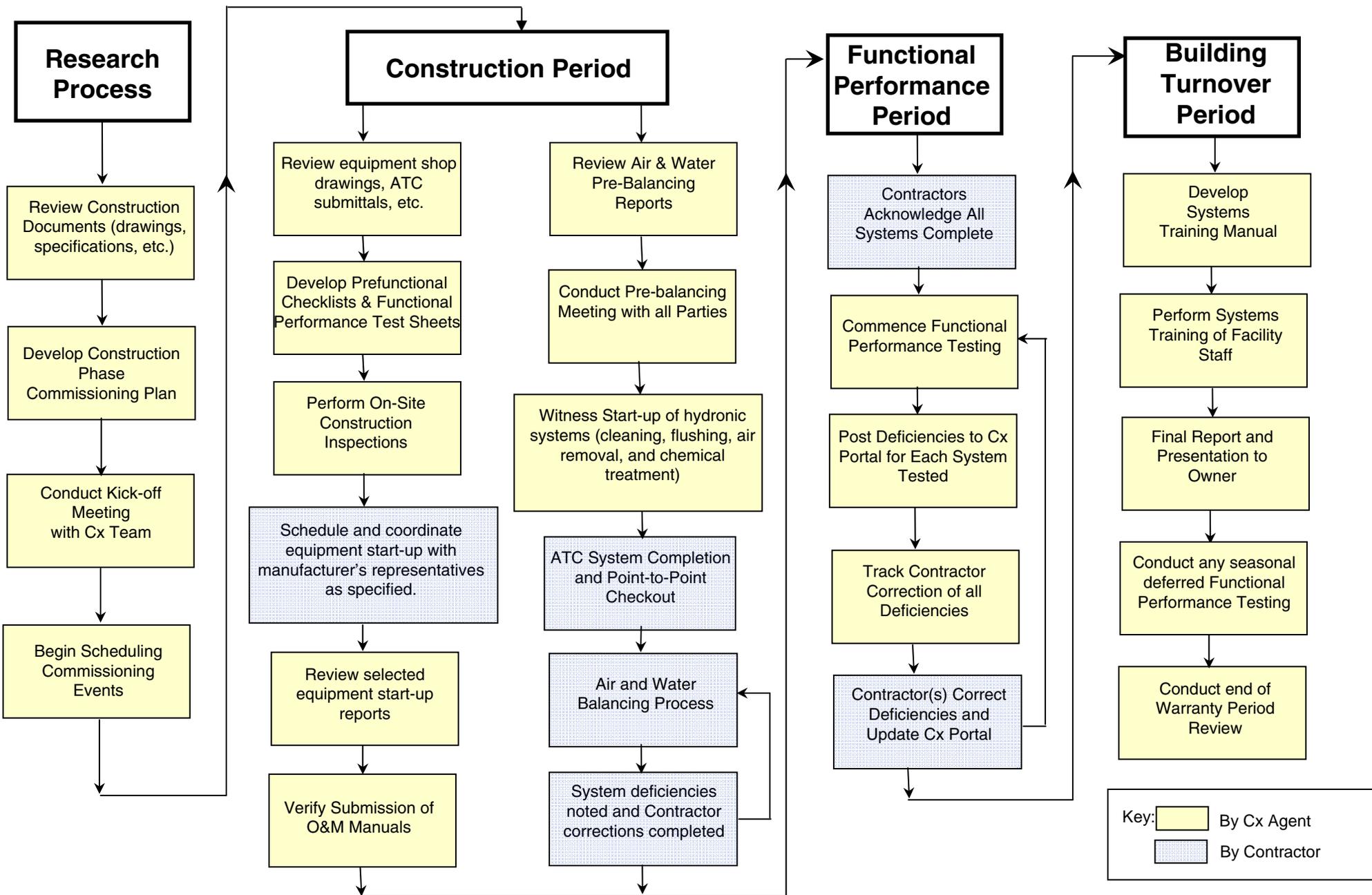
The documented warranty or construction related problems will be shared with the commissioning team. The Construction Manager or General Contractor shall be responsible for organizing the respective Subcontractors to perform any corrective actions required to resolve these problems identified.

Appendix A - Commissioning Process Flowchart

Brookhaven National Laboratory NSLS 2; Upton, New York



Commissioning (Cx) Process Flow Chart



Appendix B - Commissioning Schedule

**Brookhaven National Lab
NSLS II**

Preliminary Schedule

Subject

Date

- Commissioning Kick-Off Meeting
- Testing and Balancing Pre-Balancing Submittal
- Control Checkout Plan Submittal
- Equipment Start-up Plan / Schedule
- Submission of O&M Manuals
- Pre-Balancing Meeting
- Temperature Control Completion
 - a. Air Handlers
 - b. Fan Coil Units
 - c. General Exhaust Air Systems
 - d. Variable Air Volume Boxes
 - e. Heat Pumps and Miscellaneous Heat
 - f. Head-end Equipment and Graphics
- Testing and Balancing Completion
 - a. Air Handlers
 - b. Dehumidification Systems
 - c. Variable Air Volume Boxes
 - d. Heat Pumps and Miscellaneous Heat
 - e. Exhaust Systems
- Start of Functional Testing:
 - a. Air Handlers
 - b. Fan Coil Units
 - c. General Exhaust Air Systems
 - d. Variable Air Volume Boxes
 - e. Head-end Equipment and Graphics
 - f. Heat Pumps and Miscellaneous Heat
 - g. Domestic Hot Water System and Miscellaneous Plumbing
 - h. Lighting Control Systems

Appendix C – Manufacturer’s Equipment Start-up Checklist



SAMPLE

Manufacturer's Equipment Startup Checklist

	<i>Start Up Completed</i> <small>DATE</small>	<i>Startup Report Submitted</i> <small>DATE</small>	<i>Comments</i>
Boilers	-	-	
B-1 (Hot Water)			
B-2 (Hot Water)			
B-3 (Hot Water)			
B-4 (Steam)			
Air Handlers	-	-	
AHU-1			
AHU-2			
AHU-3			
AHU-4			
AHU-5			
AHU-6			
AHU-7			
Boiler Feed System	-	-	
BFP-1&2			
DA Tank			
Blowdown Separator			
Chemical Feed System			
Water Softener			
Glycol Feed System	-	-	
GP-1&2			
Hot Water Pumps	-	-	
HWP-1			
HWP-2			
HWP-3,4,5,6			
Chillers	-	-	
CH-1			
CH-2			
Cooling Tower	-	-	
CT-1			
Chilled Water Pumps	-	-	
CHWP-1, 2			
Condenser Water Pumps	-	-	
CWP-1,2,3			
DX Split Systems	-	-	
ACCU 1-8 / FCU 1-8			
Emergency Power	-	-	
Emergency Genset			
Computer Room System	-	-	
ACC-1 / DC-1 / WCCU-1			
Fire Pump and ATS			
Dolphin CW Trtmt System			
UPS Systems			
Sewage Pumping Station			

Appendix D – Sample Pre-Functional System Checklist



**Brookhaven National Laboratory
 NSLS II
 PRE-FUNCTIONAL SYSTEM CHECKLIST
 SAMPLE AIR HANDLING UNIT**

Mechanical Contractor	Date	Controls Contractor	Date
Electrical Contractor	Date	Sheet Metal Contractor	Date
TAB Contractor	Date	General Contractor	Date

PROJECT: NSLS II		SYSTEM I.D.#	
LOCATION: Upton, NY		EQUIPMENT I.D.#	
ITEM	OK	COMMENT	
RTU			
Factory start-up performed			
Verify internal vibration isolation spring mounts have been released from shipping			
Verify equipment guards installed			
Pulleys/sheaves aligned and belt tension adjusted			
Plenums clear and free of loose material			
Fans rotate freely and w/ proper direction			
Fan motor and bearings lubricated			
Fire dampers and fusible links installed			
Balancing dampers installed and free to operate			
Motorized OA, RA and EA damper(s) move freely and stroke when commanded			
Construction filters removed (prior to final balancing)			
Electrical connections complete			
Disconnect switch installed			
VFD installed and factory started			
Ductwork clean, sealed and pressure tested			
Verified fan rotation (through VFD <u>and</u> bypass)			
All airflow measuring stations are installed			
Duct smoke detectors installed			



PROJECT: NSLS II	SYSTEM I.D.# _____	
LOCATION: Upton, NY	EQUIPMENT I.D.# _____	
ITEM	OK	COMMENT
Piping insulation installed	<input type="checkbox"/>	
Piping identification installed	<input type="checkbox"/>	
Stainless steel drain pans installed and pitched to allow proper draining	<input type="checkbox"/>	
Condenser fans installed and rotate freely	<input type="checkbox"/>	
Compressors installed and vibration isolated from the unit	<input type="checkbox"/>	
Refrigerant piping installed per submittal.	<input type="checkbox"/>	
2" throwaway filters have been installed	<input type="checkbox"/>	
Two gas fired heating modules installed	<input type="checkbox"/>	
Dual high limit controllers per heating module have been installed	<input type="checkbox"/>	
Safety pressure switch installed in the induced draft fan	<input type="checkbox"/>	
All BAS controls have been installed and are operating properly	<input type="checkbox"/>	
COMMENTS: _____		

Appendix E – Sample Functional Performance Test Sheet

Brookhaven National Laboratory
NSLS II
Upton, NY
Date:

Air Handling Unit

AHU-1, 2, 3, 4

FUNCTIONAL PERFORMANCE TEST – RECORD SHEET

A. Documentation Requirements

Prior to the functional performance test and verification process, the Commissioning Agent requires the following documentation:

1. Air and Water Balancing Report
2. Operations and Maintenance Data
3. Verification of Warranty Periods on Equipment

B. System Components

Prior to the functional performance and verification process, the Commissioning Agent shall verify all major system components, capacities, configurations and support functions are consistent with the design or documentation received. The following shall be verified:

1. AHU Identification	AHU-1 McQuay
2. AHU Misc Info	Serves: Various Occupied Areas
	Type: Variable Volume
	Economizer: Yes
	Min OA: (1)21,600 CFM
	(2)12,200 CFM
	(3)5,420 CFM
	(4)20,650 CFM
	Supply Fan: (1)75 hp, 40,500 CFM
	(2)40 hp, 24,750 CFM
	(3)50 hp, 29,000 CFM
	(4)50 hp, 34,700 CFM
	Return Fan: External
	VFD: (2) supply and external return fan

3. Supply Fan Motor Data:
 Return Fan Motor Data:

HP	Volts	FLA	S.F.	Eff.

4. Verify duct insulation is applied in accordance with the specifications.

Compliance: _____
Non-compliance: _____

Remarks:

5. Verify fan rotation, lubrication and belt alignment for both supply fan and the return fan.

Compliance: _____
Non-compliance: _____

Remarks:

6. Verify construction start-up filters were removed and replaced with new filters (60% eff).

Compliance: _____
Non-compliance: _____

Remarks:

7. Verify installation and start-up of the VFDs. Verify proper fan rotation in bypass mode.

Compliance: _____
Non-compliance: _____

Remarks:

8. Verify both the supply and return air fans are installed with ample clearance for maintenance and repair of all components.

Compliance: _____
Non-compliance: _____

Remarks:

9. Verify supply fan, return fan and air handling unit have been properly labeled.

Compliance: _____
Non-compliance: _____

Remarks:

10. Verify fans have been statically and dynamically balanced.

Compliance: _____
Non-compliance: _____

Remarks:

11. Verify unit installation:			
	<i>Yes</i>		<i>No</i>
4" housekeeping pad installed			
Check mountings (shipping bolts removed)			
Verify equipment guards installed			
Pulleys aligned and belt tension correct			
Plenums clear and free of loose material			
Fan rotates freely			
Fan motor and bearings lubricated			
Fire and balance dampers free to operate			
Motorized dampers move freely and stroke when commanded			
Temporary start-up construction filters installed.			
Electrical connections complete			
Disconnect switch installed			
VFD installed and factory started			
Fan room clean for start-up			
Hot water coil clean and piping complete			
Cooling coil clean and piping complete			
Face and Bypass dampers operational (n/a for AHU-3)			
Condensate drains trapped and piped			
Humidifier section installation completed			
Low limit thermostat (freeze-stat) operational			
High discharge static switch operational			
Humidifier flow switch operational			
Ductwork clean and sealed			
ATC controls complete (point to point checkout)			
Bump fan to check rotation (VFD <u>and</u> bypass)			
HOT WATER COIL EQUIPMENT			
Supply and return shut off valves installed			
Strainer with blowdown valve and cap installed			
Flow measurement device installed			
Thermometers - supply and return installed			
Automatic air vent installed.			
Drain valve installed.			
Two-way modulating control valve installed			
Casing penetrations are sealed			
CHILLED WATER COIL EQUIPMENT			
Supply shut-off valve installed			
Strainer installed			
Two-way modulating control valve installed.			
Thermometers -supply and return installed.			
Air vent installed.			



Capped drain valve installed.			
Flow measuring device installed.			
Ball balancing valve w/ memory stop installed.			
Casing penetrations are sealed and will not leak			
Condensate drain pan trapped and piped.			
Piping Insulation Complete			
Piping Identification Installed			
Valve Tagging Complete			
HUMIDIFIER BANK EQUIPMENT			
Dirt leg installed			
Shut off valve installed			
Strainer installed			
Modulating steam control valve installed			
Trap assembly (trap, check, iso valve) installed			
Condensate bypass w/ shut off installed			
Check vertically mounted dispersion tube is clean.			
Casing penetrations are sealed and will not leak			
Drain pan trapped and piped			
Piping Insulation Complete			
Piping Identification Installed			
Valve Tagging Complete			

Remarks: *60% filters for AHU-1,2,3,4,6,7 30% for AHU-5*

C. Functional Performance Testing

1. Verify installation and calibration of the outdoor air temperature sensor. Record location. Compliance: _____
Non-compliance: _____

Remarks:

2. Verify installation and calibration of the outdoor air humidity sensor. Record location. Compliance: _____
Non-compliance: _____

Remarks:

3. Verify installation and calibration of return air temperature sensor. Compliance: _____
Non-compliance: _____

Remarks:

4. Verify installation and calibration of common return air humidity sensor. Compliance: _____
Non-compliance: _____

Remarks:

5. Verify installation and calibration of mixed air temperature sensor. Compliance: _____
Non-compliance: _____

Remarks:

6. Verify installation and calibration of discharge air temperature sensor. Compliance: _____
Non-compliance: _____

Remarks:

7. Verify installation and calibration of discharge air humidity sensor. Compliance: _____
Non-compliance: _____

Remarks:

8. Verify installation and calibration of outside air flow sensor. Compliance: _____
Non-compliance: _____

Remarks:

9. Verify installation and calibration of supply air flow sensor. Compliance: _____
Non-compliance: _____

Remarks:

10. Measure and record unit total supply airflow (40,500 cfm design). Compliance: _____
Non-compliance: _____

Remarks:

11. Measure and record minimum outdoor airflow (21,600 cfm design). Record damper command. Compliance: _____
Non-compliance: _____

Remarks:

12. Verify start/stop capability and occupancy schedule operation.

Compliance: _____
Non-compliance: _____

Remarks:

13. Verify optimal start warm-up capability. Verify warm-up mode to meet space temp at scheduled occupancy time. If the return air is at least 2 degrees below setpoint and the outside air is ≤ 60 degrees, the unit will start in warm-up mode. The bypass dampers will close and the unit will maintain a 70 degree DAT. Opt start can occur once per day. Max opt start run time is 2 hours. Opt start terminates by reaching 69 degree RAT at all four sensors or occ time.

Compliance: _____
Non-compliance: _____

Remarks:

14. Verify optimal start cool-down capability. Verify warm-up mode to meet space temp at scheduled occupancy time. If the return air is > 2 degrees above setpoint and the outside air is ≥ 60 degrees, the unit will start in cool-down mode. The bypass dampers will close and the unit will maintain a 55 degree DAT. Opt start can occur once per day. Max opt start run time is 2 hours. Opt start terminates by reaching 73 degree RAT at all four sensors or occ time.

Compliance: _____
Non-compliance: _____

Remarks:

15. Verify morning cool down by economizer capability. If the OA enthalpy is below the RA enthalpy, the unit will allow the RA damper to modulate more closed to maintain a DAT of 55 degrees. Morning cool down terminates when the RAT falls to 73 degrees at all four sensors or the scheduled occupancy time occurs.

Compliance: _____
Non-compliance: _____

Remarks: *Not in sequence – waiting for clarification.*

16. Verify night set-back capability. If space temperature falls to 55 degrees, the unit will start and run with the OA dampers *closed*, in full return mode, with the HW valve will control to a DAT of 70 degrees. Night set-back mode stops when the space temperature rises to 69 degrees.

Compliance: _____
Non-compliance: _____

Remarks: *Spec indicates that unit will start as in occ mode for night setback. Waiting for clarification.*

17. Verify night occupancy override capability. If any space has been placed into night override (**HOW? – local sensor button or graphics?**), the unit starts and controls in night set-back mode. Time duration = 2 hours (adj)

Compliance: _____
Non-compliance: _____

Remarks:

18. Verify unit casing temperature control during unoccupied periods. If the mixed air temperature drops below 40 degrees, the HW valve will modulate open to maintain 50 degree duct temperature.

Compliance: _____
Non-compliance: _____

Remarks:

19. Verify night set-up capability. If space temperature rises to 85 degrees, the unit will start and run with the OA dampers closed, in full return mode, with the CHW valve will control to a DAT of 55 degrees. Night set-up mode stops when the return temperature falls to 73 degrees at all four sensors.

Compliance: _____
Non-compliance: _____

Remarks: *Not in sequence – waiting for clarification.*

20. Verify return fan operation during optimal start and night heating or cooling modes:
➤ The speed of the return fans shall be controlled so the total return air flow matches the total supply air flow for the operating AHUs (1 through 4).

Compliance: _____
Non-compliance: _____

Remarks:

21. Verify return fan operation during occupied mode:
➤ The speed of the return fans shall be controlled to maintain the RA CFM setpoint:
RA = Σ SA – Σ OA (3 RA flows and 4 each OA and SA flows)

Compliance: _____
Non-compliance: _____

Remarks:

22. Verify supply fan status is interlocked with damper operation:
- When all supply fans are stopped the outdoor air damper is closed, the common exhaust damper is closed and the return damper is closed
 - When the supply fans are energized the associated dampers modulate to maintain design conditions.

Compliance: _____
Non-compliance: _____

Remarks:

23. Verify unit operation during occupied mode. Verify the following occurs:
- Supply and return fans operate continuously
 - OA damper goes to it's min position
 - Return damper modulates to maintain the rated min OA for each unit
 - HW valve or F/B dampers, CHW valve and OA dampers modulate to maintain DAT setpoint

Compliance: _____
Non-compliance: _____

Remarks:

24. Verify DAT during occupied mode: DAT will typically be maintained at 55 degrees, unless there is a cooling request from the local space VAV box controller which will lower the discharge air temp to 52.1 degrees.

Compliance: _____
Non-compliance: _____

Remarks: *Cooling call parameters?*

25. Verify mixed air low limit control:
- If MA temp drops below 55 degrees, the OA dampers will begin to close towards the min OA position.

Compliance: _____
Non-compliance: _____

Remarks: *Not in sequence. Verify if used.*

26. Verify unit operation during unoccupied mode. Verify the following occurs:

- Supply and return fans are de-energized.
- Outdoor air and relief dampers closed.
- Return damper opened.
- Hot water valve is closed
- Chilled water control valve is closed.
- Hot water valve is closed

Compliance: _____

Non-compliance: _____

Remarks:

27. Verify operation of face and bypass damper or HW valve to maintain DAT setpoint:

- If OA is <40 degrees, the HW valve will be 100% open and the face and bypass dampers will modulate to maintain DAT
- If the OA \geq 40 degrees, the face and bypass dampers will be open to the coil and the HW valve will modulate to maintain DAT.

Compliance: _____

Non-compliance: _____

Remarks:

28. Verify cooling coil is locked out from operating in the heating mode.

Compliance: _____

Non-compliance: _____

Remarks:

29. Verify operation of cooling coil control valve to maintain DAT setpoint.

Compliance: _____

Non-compliance: _____

Remarks:

30. Verify hot water control valve is locked out from operating in the cooling mode.

Compliance: _____

Non-compliance: _____

Remarks:

31. Verify operation of humidifier. Compliance: _____
Non-compliance: _____

- Humidifier valve will be modulated open if RA humidity drops below 30% RH
- Discharge air RH sensor shall modulate the valve closed if the humidity exceeds 65%.
- Air flow switch will not allow humidifier valve to open if there is no flow.

Humidifiers in AHU-1 through 4 operate in unison.

Remarks:

32. Verify economizer operation (occupied mode): OA damper, RA, and EA damper modulate in sequence as long as OAT enthalpy is less than RAT enthalpy. EA damper modulates open to maintain RA static setpoint. Compliance: _____
Non-compliance: _____

Remarks:

33. Verify in operation of supply and return fan VFDs in hand mode or bypass: Compliance: _____
Non-compliance: _____

- Smoke isolation dampers open and prove.
- VFDs start and ramp up.
- Verify proper rotation in bypass mode.

Remarks:

Alarms and Safeties

34. Verify installation and operation of freeze-stat. When tripped by temp below 38 degrees, supply and return fans shut down, OA and EA dampers close, HW valve opens fully, F & B dampers go to full bypass, alarm is generated at workstation. Compliance: _____
Non-compliance: _____

Remarks: ***Manual reset t'stats required.***

35. Verify operation during smoke condition. Compliance: _____
Non-compliance: _____

- Supply and return fans shut down
- OA and EA dampers close
- HW and CHW valves close
- Supply and Return smoke dampers close after 60 second delay.

Manual reset required at workstation to reset unit

Remarks:

36. Verify operation of supply fan discharge high static
 ➤ Unit is shut down
 ➤ OA dampers close
 ➤ RA Dampers open

Compliance: _____
 Non-compliance: _____

Remarks:

37. Verify operation of return fan discharge high static
 ➤ Return fans are shut down
 ➤ All supply fans are shut down (1 – 4)
 ➤ RA Dampers open

Compliance: _____
 Non-compliance: _____

Remarks:

38. Verify alarm is generated at the facilities workstation on a loss of:
 ➤ Supply fan status (after ? min.)
 ➤ Return fan status (after ?min.)
 ➤ Freeze condition (after ? min.)
 ➤ High static (after ? min.)
 ➤ Smoke or fire alarm condition

Compliance: _____
 Non-compliance: _____

Remarks:

39. Verify that the following conditions will shutdown the unit via hard wired interlock and generate an alarm at the facilities workstation and FACP:
 ➤ Activation of supply duct smoke detector.
 ➤ Activation of return duct smoke detector.
 ➤ General alarm signal form the FACP.

Compliance: _____
 Non-compliance: _____

Remarks:

40. Verify the following information is available and accurate at the operator's workstation:			
	<i>Yes</i>		<i>No</i>
a. AHU System Graphic			
b. Occupied / Unoccupied Status			
c. Supply Fan Start/Stop			
d. Supply Fan Status / Alarm			
e. Return Fan Start/Stop			
f. Return Fan Status / Alarm			
g. Discharge Air temp			
h. Return Air Temp			
i. Face and Bypass Damper			
j. Outdoor Air Damper			

k.	Outdoor Air Flow			
l.	Return Air Damper			
m.	Outdoor Air Flow			
n.	Hot Water Valve			
o.	Chilled Water Valve			
p.	Chilled Water Coil LAT			
q.	Low Temp Thermostat			
r.	Steam Humidifier			
s.	SA Static Pressure			
t.	RA Static Pressure			
u.	SF Speed			
v.	SF Airflow			
w.	RF Speed			
x.	Mixed Air Temp			
y.	Heating Coil LAT			

Remarks:

Notes:

1.



Appendix F – BVH Commissioning Portal User's Manual

2007

Commissioning Portal User Manual

Version 3.0 May 2007

The BVH Commissioning Portal is an online tracking database. The portal is used by the commissioning Agent to track issues and assign responsibility for corrective action. All members of the commissioning team will be given access to the Commissioning Portal as required to respond to issues or deficiencies.

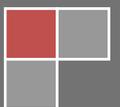


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Connecting to the Commissioning Portal

Connect to the Internet and open the web browser of your choice, in the address bar type the address of the commissioning portal below or click on the link

<http://cx.bvhis.com>

Note: There is no "www" at the beginning of the site address.

Sign on and Sign off

Once the site has finished loading, you will see the login screen show in Figure 1 below. If you have already been provided with a username and password by BVH then enter it in the proper fields and click the Sign In link.

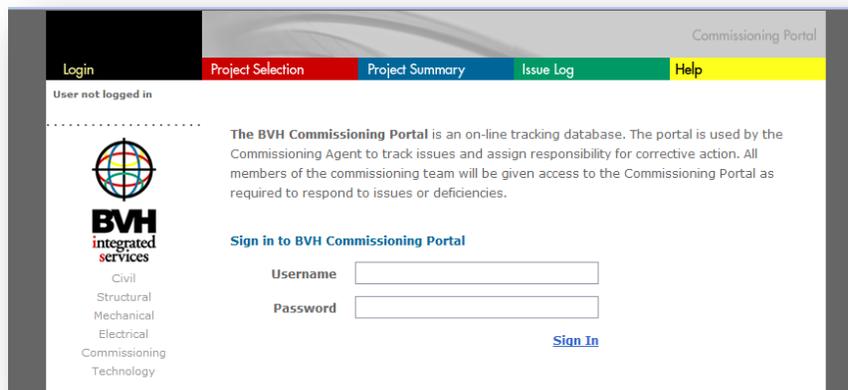


Figure 1

*Note:
Your username is typically your full email address. Please ensure the Commissioning Provider has your most up to date email address.*

Navigating the Commissioning Portal

When navigating between sections of the portal please use the links at the top of each page. When responding to issues please use the provided links, such as **'Back to Issues'**, to return to your previous page. Using the portal's links ensures all of the information you see will be the most up to date and include any items just entered from another page. Using your browsers back button will only return you to the instance of page you previously viewed including any old data. In some instances it can even generate an error that will require you to sign out of the Commissioning Portal, close your browser, then return to the page and sign in again to continue working.

Project Selection

After you have signed onto the Commissioning Portal the project selection screen shown in Figure 2 below will appear. Select the project you are working with via the drop down menu, and then click on the 'Enter Project' link.



Figure 2

Note:

If you are involved with multiple commissioning projects, they should all be listed in this pull down menu. You are only given access to projects that you are involved in and been assigned to by BVH.

Project Summary

Once you have selected and entered a project from the Project Selection page you will be taken to the project summary screen shown in Figure 3 below.

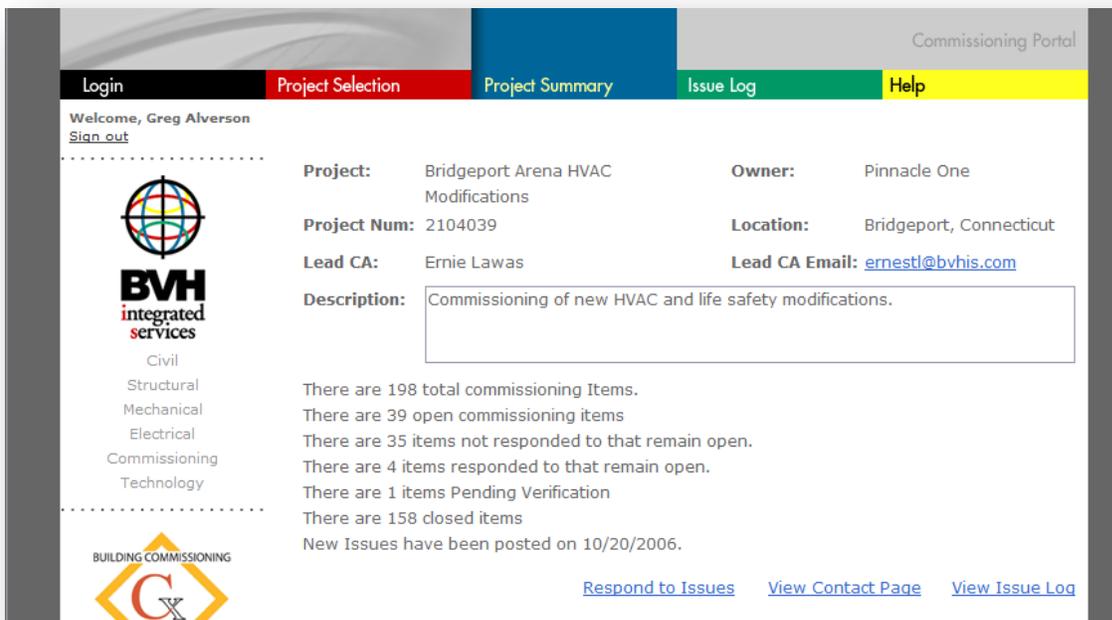


Figure 3

This screen indicates the name of the project, the owner, the lead Commissioning Provider (Lead CA), and other information about the project along with a brief description of the project itself. To contact

the lead Commissioning Provider via email click on the email address listed and a new message will open in your default email program already addressed to the Lead Commissioning Provider.

Additionally, there is a list of the statistics regarding the issues or deficiencies documented to date on the project such as the total number of issues identified and the number of outstanding issues not yet responded to.

An important statistic to note is the line that indicates when new issues have been last posted. This will be useful when responding to outstanding items. As an example, if the "New Issues Posted On" date has not changed since the last time you responded to new items, there are no new items for you to respond to.

Note: This does not mean that the responsibility of items has not changed from one party to another since that date. You should still review the issues log for any items assigned to you.

Respond to Issues

See instructions under the [Responding to Issues](#) section of the Issue Log for more detailed information.

View Contact Page

To Display a list of all of the current commissioning projects Contacts click on the **'View Contact Page'** link located in at the bottom of the Project Summary page. This will create a PDF file, which may be printed or saved to your computer, containing a listing of all the jobs contacts including their trades, phone numbers, and email addresses.

Once you have completed viewing the Contact list you must use the **Browser's Back button** to return to the project summary screen.

View Issue Log

The **'View Issue Log'** link Located in the bottom right of the Project Summary page will direct you to a table of all the documented Issues/deficiencies for the project. For more detailed instructions see the **Issue Log** Section of this Manual.

Issue Log

After clicking on the View Issue Log link from the Summary Page you will be taken to the Issue Log page for the current project shown in Figure 4. This Issue Log displays a table of all the documented Issues and deficiencies for the commissioning project.

Note: It may take a few moments for the table to finish loading and display all of the issues for a project, as the table may contain many items. Please be patient and do not click on the page until it has finished loading.

Welcome, Greg Alverson
[Sign out](#)

Bridgeport Arena HVAC Modifications

Trade: Status:

No.	Tag	Item Description	Action By	Posted	Status	Response
23	CH-1, 2, 3	Flow meter installed in the secondary loop is not an ultrasonic meter. Per specification 15122-4, an ultrasonic flow meter is required. Contractor to correct.	TM	11/8/2005	Open	5/17/2006 TM - New dual channel flow meter installed, however foaming of the glycol was occurring and generating unreliable meter readings. TMC added defoaming agent to system on 5/16/06. Meter can be rechecked w/o 5/22/06. 2/23/2006 TM - Price of single ultrasonic meter is \$4,150.00, price of dual ultrasonic meter is \$6,370.00, difference of \$2,220.00. 2/15/2006 TM - ABS to forward dual flow meter submittal for engineer approval 11/18/05 TM - ABS to research and provide comment 1/18/06: ABS to price dual flow meter and TMC will weigh cost options.

Status: Ok Visible on the page: 1 - 40 Total visible: 40 Total rows: 40

[Add Issue to Log](#)
[Project Contacts](#)
[Action Codes](#)
[Printable Version](#)
[Respond to Issue](#)

Figure 4

The Issue Log may consist of multiple pages depending on the number of items. Each page of the Table can contain up to 50 items. The scroll bar on the right of the table will allow you to scroll to the bottom of the grid and view all 50 items on that page. If there are more than 50 items then you will need to continue on to the next page of the grid to view additional items. You can change the page of the table you are viewing by clicking on the **Next Page** button at the bottom of the table, or selected the page number you wish to view.

Filtering and Sorting the Issue Log

The Issue Log may be filtered by using the pull down menus show in Figure 5 below.

Commissioning Portal

Project Selection Project Summary Issue Log Help

Bridgeport Arena HVAC Modifications

Trade: Status:

No.	Tag	Item Description	Action By	Posted	Status	Response
						10/25/2006 BVH - metal tags to be riveted to motor

Figure 5

The Issue Log table may be filtered by both trades (Mechanical Contractor, Electrical Contractor, Etc.) and by the Status of an item (Open, Closed, Pending Verification) Filtering the Issue Table will allow you to review only those items belonging to a particular trade and status reducing the number of items displayed.

Note: The Filters apply to both the displayed table and the printable Reports.

The Issue Table may also be sorted by any of the columns displayed in either ascending or descending order. To sort the table by one of the columns click on the header of that column. A small arrow will appear to the right of the column title pointing either up or down depending on if the column is sorted in ascending order or descending order. To change the direction the table is sorted click on the same column header again. To return to the default sorting order of the table, sort by the No. column.

Add Issues to Log

The 'Add Issues to Log' link, shown in Figure 6, may be disabled depending on your permissions. Only the commissioning provider can add new issues to the Issue Log.

Project Contacts

See detailed instructions under the [View Contact Page](#) Section of the Manual.

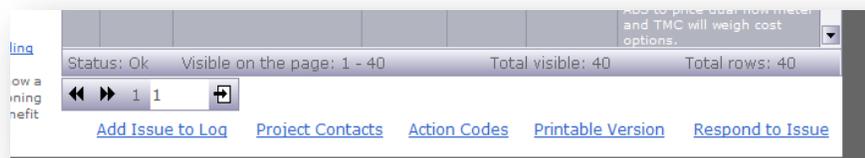


Figure 6

Action Codes

To display a key for the Action by column click on the **Action Codes** link at the bottom of the page, shown in Figure 6. This will create a dialog box displaying each abbreviation used in the Action by column and their corresponding company names.

Printable Version

To display a printable version of the Issue/Deficiency Log click on the **Printable Version** link located at the bottom of the page, shown in Figure 6. This will create a PDF file that can be easily printed or saved to your computer. Once you are finished with the printable report you must use the **Browser's Back button** to return to the Issue log page.

Note: It may take a moment for the PDF file to be generated and open please be patient and wait for it to complete.

Responding to Issues

To respond to Issue in the Issue log first select the row of an issue you would like to respond to then click the **Respond to Issues** Link found in the bottom right of the Issue Log page. This will direct you to a new page to enter in your response shown in Figure 7. You can also get to this page using the link found on the Summary Page.

There are fields to display the Project Name, Item Number, Item Tag, Item Status, Item Description, who is responsible for the item, and all previous responses. The last field is where you will enter your new response to be added to an item, this is the only field you will be able to type in all the other field are for information only and may only be changed by the Commissioning Agent. You will only be able to respond to items in which your company is listed in the "Action By" column and have a status of "Open".

Commissioning Portal

Login Project Selection Project Summary Issue Log Help

Welcome, Greg Alverson
[Sign out](#)

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Add Response

Project Name: Bridgeport Arena HVAC Modifications Item No. 1

Item Tag: CHWP-1, 2, 3

Action By: Titan Mechanical Status: Open

Description: All of the primary chilled water pump nameplate data indicates a "0 gpm @ 0' head" rating. This should represent design conditions. Contractor to correct.

Previous Response:

- 10/25/2006 BVH - metal tags to be riveted to motor base rail.
- 5/17/2006 TM - TMC requests that, due to pump insulation jacket, laminated tags be chain mounted to pumps in lieu of engraving existing tags. Please advise.
- 2/2/2006 BVH - Pump performance information has been verified with ETB for the new impellers. Nameplate's can be obtained for the design conditions.

New Response:

[Add Response](#) [Back to Issue Log](#)

Figure 7

The Item number pull down allows you to switch easily between item rows simply by changing the number; the other fields on the page will change accordingly with the information for the new item. This can be extremely useful when you have many items to respond to. If the item has been incorrectly assigned to your company, please respond to the item accordingly and the Commissioning Agent will correct the issue and assign it to the proper party.

Tip: To Quickly respond to many items it is suggested that you print a report of the Issue/Deficiency log filtered (See Filtering and Sorting section of the manual for instructions.) by your companies roll in the job prior to beginning your responses. This will allow you to know the numbers of all the items you are responsible for and quickly switch between them without retuning to the Issue Log page and waiting for it to load.

Adding your Response

To begin adding your response ensure that the proper item number is displayed in the pull down at the top right of the page. Once the proper Item has been selected begin typing your response in the **New Response** field. The date and name of your company will be automatically added before your response when you post the response, Please do not type them manually. When you have completed the contents of your response, click the **'Add Response'** Link to post your response to the issue log. You should see the Previous response field update with your new response at the top.

Once you have completed your response you may continue to response to additional items by switching the Item number pull down in the upper right to another number, or return to the Issue Log by clicking the **Back to Issue Log** Link in the bottom right of the page.

Troubleshooting

Frequently Asked Questions

- How do I get a Username and **Password**?
- I have a Username and Password, How do I Sign in?
- I signed in, why do I get logged off automatically?
- I forgot my username and/or password.

How do I get a Username and Password?

To create an account you will need to speak to the commissioning Agent in charge of your project. He will require you to give him details such as your email address, company, and roll in the project. A login and password will be emailed to you after speaking with the Commissioning Agent.

[above](#)

I have a Username and Password, How do I Sign in?

You should have received a username and password from your Commissioning Agent. You can then visit the login page and enter your username and password to login. Please remember that your password is case sensitive so capital or lower case letters make a difference.

[above](#)

I signed in, why do I get logged off automatically?

You will be automatically logged off after an administrator-defined length of inactivity, usually 20 minutes. This is a security precaution to prevent anyone else from using your login on a computer you used previous.

[above](#)

I forgot my username and/or password.

If you forgot your username and/or password you should contact your commissioning agent and he can supply you with your password and ensure your login works correctly. Once you receive your username and password you can login.

above

Common Errors

The following section describes common problems you may encounter while using the Commissioning Portal. Listed here are solutions to the most common problems that may arise, if your problem is not solved here then please contact BVH for further support.

Pop-Up Blocking: If you are experiencing problems with not seeing additional windows that pop up as part of the portal, your explorer pop-up blocker may be active or third party internet security software maybe blocking those windows.

To correct windows explorer from blocking the pop-up windows associated with the portal, you will need to go to the tools drop down menu in explorer. Access the pop-up blocker, then pop-up blocker settings.

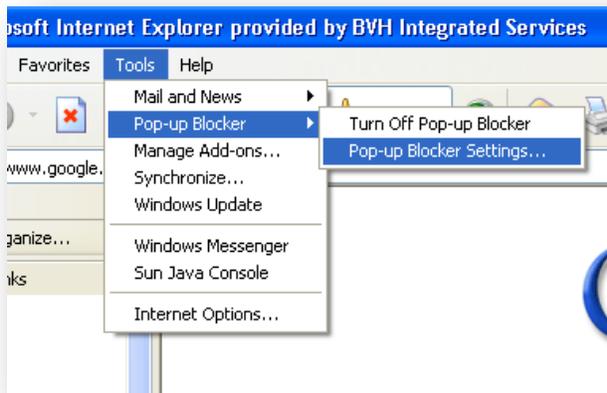


Figure 8

In the pop-up blocker settings window, you must add the BVH portal website address to allow pop-ups when visiting this site. Enter the following address, cx.bvhis.com, then click add and close the window when finished.

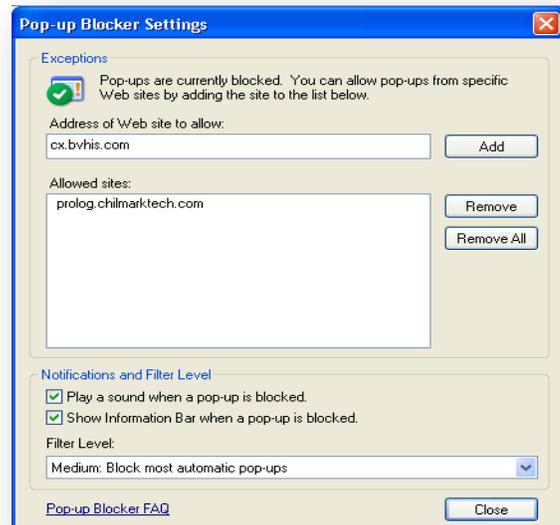


Figure 9

If other third party internet security software is blocking the pop-up windows, you will have to consult your user's information for that software to allow the pop-ups when logged onto the commissioning website.

Problems with the Printable Version

The **Printable Version** link on the webpage creates a PDF file and launches *Adobe Acrobat Reader* to display it. If you are having problems with this feature, changing the following security setting in Internet Explorer, should make the **Printable Version** work properly.

Start Internet Explorer. Under the Tools drop-down menu, select Internet Options. Select the Security tab at the top. The window shown in Figure 10 below will be displayed.

When the Security Settings window is displayed select the Internet Zone near the top and then select the **Custom Level** button at the bottom of the Dialog. The window show in Figure 11 should be displayed. Scroll down through the settings until you find Downloads, as shown in Figure 11 below.

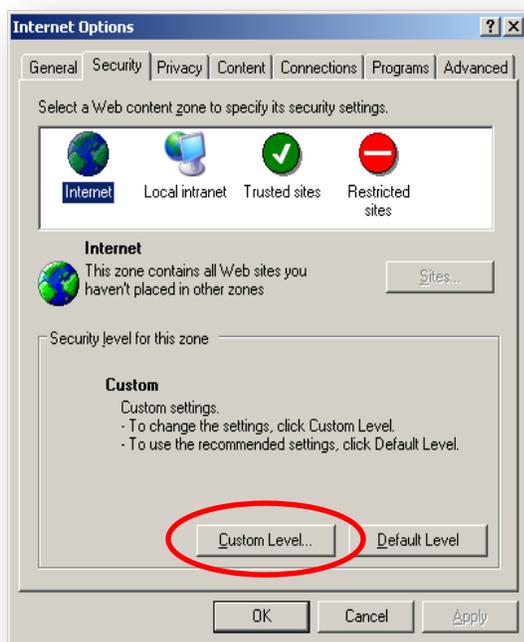


Figure 10

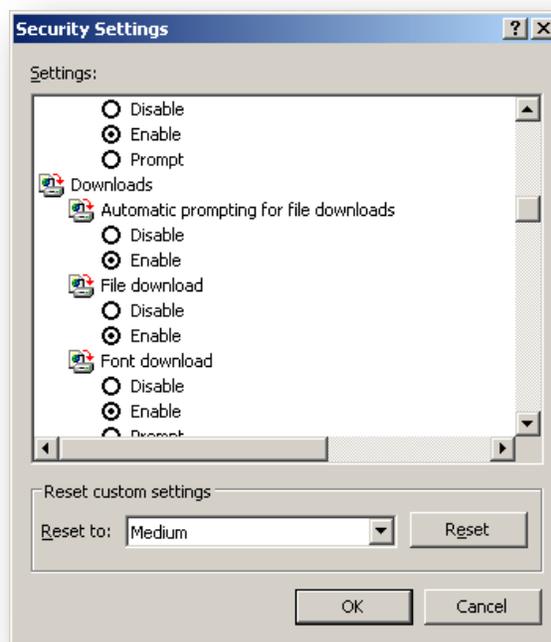


Figure 11

Enable the **Automatic prompting for file downloads**, then Select OK. When you click on the Printable version link next time you should receive a message asking you to save or open the file. Choosing open will allow you to view the report online, while save will save a copy to your local computer.

Contact Support

If the information in this manual does not help you to resolve your issue, Please contact the support staff by calling BVH at (860) 286-9171 and speaking to Greg Alverson (ex. 7478) or Tom Kazmierczak (ex. 7452)