

FINAL COMMISSIONING REPORT

Greybull Elementary School Big Horn County School District No. 3

General

EMC Engineers, Inc. (EMC) served as the commissioning (CxA) agent for this project for Big Horn County School District No. 3. EMC provided technical support during design, installation, and commissioning of the mechanical systems. This report summarizes the commissioning activities and consulting for completion of the construction of Greybull Elementary School.

The scope of commissioning activities included the following major tasks:

- Provide commissioning specifications, which were incorporated into the General Requirements, Mechanical and Electrical systems sections.
- Development of a commissioning plan.
- Review of mechanical submittals.
- Review of control submittals, including a thorough review of the proposed control sequence.
- Perform periodical construction phase job walks and provide construction observations.
- Preparation of prefunctional checklists for the new mechanical equipment, including the ground source heating and cooling water systems, air-handling units, heat recovery units, heat pumps, duct furnaces, a gas unit heater, and exhaust fans.
- Witnessing selected startup activities for major mechanical equipment.
- Procurement and oversight of the testing, adjusting, and balancing (TAB) contractor.
- Preparation and implementation of functional test procedures to verify the proper control and operation of the mechanical systems.
- Preparation of a list of deficiencies discovered during the functional test procedures.
- Assist in preparation of systems training for school district personnel.
- Preparation of a final commissioning report.
- Review of the Operation & Maintenance (O&M) Manual.
- Preparation of a Systems Manual.
- Perform end-of-warranty walk through the building.

Systems Commissioned

The scope of work required that the specific mechanical and electrical system receive commissioning. The following table summarizes the systems that were analyzed.

Table 1. Summary of Mechanical and Electrical Systems Commissioned

Systems and Major Items	Prefunctional Checklists	Functional Testing
Mechanical Equipment		
Air Handling Unit	✓	✓
Heat Recovery Units	✓	✓
Terminal Units (Heat Pumps)	✓	✓
Gas Unit Heater	✓	✓
Ground Source Heating and Cooling System	✓	✓
Exhaust Fans	✓	✓
HVAC Controls		✓
TAB Services		
Electrical Equipment		
Distribution Cables		
Main Breakers & Distribution Panels		
Lighting and Lighting Controls		✓
Ground Fault Detection		
Emergency Generator		

Results of Commissioning

Design Review

Refer to section **A-6 Design Review** for commissioning results for the design review.

Equipment Installation

Commissioning activities during this phase included the following.

- **Submittal review.** Submittal data is included in the Final Commissioning Report for the major mechanical equipment, including the boilers, chiller, cooling tower, pumps, and AHUs. A thorough review was performed on the HVAC controls, including the controls drawings and control sequences. The review comments on the controls sequences are included under **Tab D-01 – HVAC Controls**.
- **Construction Observations.** Construction observations were made at various construction stages and provided the General Contractor, Owner and various other parties. Also EMC also compiled a lessons learned document that outlined issues that were problems at Rocky Top and Shadow Ridge Middle Schools that needed to be addressed at Silver Hills Middle School.
- Creation of **pre-functional checklists** for equipment. Pre-functional checklists were created for the equipment, as noted in Table 1. The

appropriate subcontractor was required to fill out the pre-functional checklist for each device. These checklists are included for the following equipment.

Table 2. Summary of Pre-functional Checklists

PC-01	HP 1-1 to HP 1-4	PC-09	HP 2-16
PC-02	HP 1-5 to HP 1-8	PC-10	AHU-1, HRV-1 & HRV-2
PC-03	HP 1-9 to HP 1-12	PC-11	EF-1 to EF-4
PC-04	HP 1-13 & HP 1-16 to HP 1-18	PC-12	EF-5 to EF-7
PC-05	HP 1-19 , HP 1-20, HP 2-1 & HP 2-2	PC-13	HPDP-1, HPDP-2 & CP-1
PC-06	HP 2-3 to HP 2-6	PC-14	DF-1 & DF-2
PC-07	HP 2-7 to HP 2-10	PC-15	GUH-1
PC-08	HP 2-11 to HP 2-15		

- **Witnessing equipment startup.** EMC personnel were on-site to witness the startup of the boilers, chiller, cooling tower, emergency generator, and various rooftop air handling units.

Automatic Controls

The bulk of the commissioning activity was focused on the automatic controls system and in verifying the proper operation of the mechanical systems. The systems were commissioned through the following steps:

- Reviewing mechanical and control submittals and drawings.
- Providing feedback on the proposed sequence of operation. Minor modifications were made to the sequence.
- Preparing and executing an extensive functional test procedure to verify the control sequences under actual operation.
- Working with the contractor and facility personnel to identify and resolve deficiencies in the operation of the mechanical system.

The most important part of the commissioning process was the preparation and execution of the functional test procedures. The functional test procedures were created to provide a systematic method for testing the controls sequence. The main focus of the test procedures was to:

- Verify the automation of equipment operation within specific modes. These sequences were typically based on building load requirements, outside air conditions, or operator selections.
- Verify that the controls system will register the correct alarms to the BAS central station. Once equipment was manually disabled, the controls system was observed to determine if the correct alarm was detected in a timely fashion.

The majority of control functions were demonstrated to EMC by Western Building Services and proved to be operating properly. The few deficiencies that were discovered during the functional procedure are discussed in *Section A-3, Final Issues Log*. Many of the deficiencies found during the initial test were corrected and retested. The retested deficiencies were found to be working properly. The functional testing procedures are described in the following sections.

Table 3. Equipment Requiring Functional Test Procedures

Tab B-01	Heat Pumps 1-1 through 2-16	Tab B-04	EF-1 through EF-7 & GUH-1
Tab B-02	AHU-1, HRV-1 & HRV-2	Tab C-01	HPDP-1, HPDP-2 & CP-1
Tab B-03	DF-1 & DF-2		

TAB Contractor Oversight

EMC was responsible for oversight and management of the TAB contractor. EMC observed a portion of the airside and waterside TAB activities, as well as performed extensive testing on airside systems, in order to verify that it was being executed according to the design intent. The results of the TAB validation activities can be found in *Tab D-02 – Testing, Adjusting and Balancing Report*.

Electrical Systems

EMC completed the following commissioning activities for the electrical system.

- **Daylight Controls.** EMC performed functional testing on the daylight controls to ensure proper operation. These tests were performed in conjunction with functional testing on the Heat Pumps. Documentation can be found under *Tab B-01 Heat Pumps*.