COMMISSIONING | ENERGY & ANALYTICS | QUALIFICATION AND VALIDATION

GMCCX
ELEVATING PROJECT DELIVERY

COMMISSIONING PLAN

Morongo CoGen

DOCUMENT NO.	**CxP-2025063**
OWNER	**Morongo Band of Cahuilla Mission Indians**
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Document Revisions

Date	Modified By	Revision	Description
01.26.26	Alex Mathers	0	First Issue
06.08.26	Alex Mathers	1	Added Phase 1 scope and testing approach; restructured load bank and temp gen sections by phase; updated per design team coordination and E-601 testing configuration

Definitions and Acronyms

Acceptance Criteria: Predefined and agreed upon testing results that must be met under defined operating conditions. Acceptance criteria should be prescriptive or performance-based requirements with defined tolerances and conditions.

Contract Documents: Typically includes drawings, specifications, price agreements, construction management process, subcontractor agreements or requirements, requirements and procedures for submittals, and any other negotiated terms.

Coordination Drawings: Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and repair.

Issues Log: A formal and ongoing record of problems, issues or concerns, and their resolution, that have been raised by members of the Commissioning Team over the course of the Commissioning Process.

Substantial Completion: A major milestone where a project has been completed to the point where the owner can move in and use the premises for their intended purposes.

Systems Manual: A system-focused composite document that includes the Commissioning Record, operation manual, maintenance manual, and additional information of use to the owner during the Occupancy and Operations Phase.

Training Plan: A written document that details the expectations, schedule, budget, and deliverables of Commissioning Process activities related to training of project operating and maintenance personnel.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

A/E: Architect / Engineer

AOR: Architect of Record

ASHRAE: American Society of Heating, Refrigeration, and Air-Conditioning Engineers

BAS/ECMS: Building Automation System / Energy Control and Monitoring System

BESS: Battery Energy Storage System

BOD: Basis of Design

CC: Controls Contractor

CHP: Combined Heat and Power

CM: Construction Manager

CO: Certificate of Occupancy

Cx: Commissioning

CxA: Commissioning Authority

CxP: Commissioning Plan

EC: Electrical Contractor

EMCS: Energy Management and Control System

EOR: Engineer of Record

FDD: Fault Detection and Diagnostics

FPT: Functional Performance Test

GC: General Contractor

IST: Integrated Systems Test

MC: Mechanical Contractor

MBCx: Monitoring-Based Commissioning

NETA: InterNational Electrical Testing Association

O&M: Operation and Maintenance

OPR: Owner's Project Requirements

PC: Plumbing Contractor

PFC: Pre-Functional Checklist

PM: Project Manager

PMS: Power Management System

PTP: Point-to-Point Verification

PVT: Pre-Verification Test

RACI: Responsible, Approves, Contributes, Informed

SOO: Sequence of Operations

TAB: Test, Adjust, and Balance

VFD: Variable Frequency Drive

Purpose

Commissioning is the systematic quality assurance process of proactively verifying facility equipment and systems are installed and operating appropriately and meet all user requirements and stakeholder expectations.

The purpose of the Cx Plan is to present, explain, and direct the commissioning process in its entirety, including scope, schedule, meetings, activities, deliverables, and Commissioning Team (Cx Team) member responsibilities.

This plan is developed in accordance with:

- ASHRAE Guideline 0-2019, The Commissioning Process
- ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process
- ANSI/NEBB S110-2019, Standards for Whole Building Systems Commissioning of New Construction
- BCxA Best Practices for Commissioning Existing Buildings (applicable sections)
- ACG Commissioning Guideline
- California Title 24, Part 6, Sections 120.5 through 120.8
- California Green Buildings Standard - CALGreen (Title-24 Part 11)

Commissioning Process

The commissioning process follows the five-phase structure defined in ASHRAE Guideline 0-2019. Each phase has defined activities, deliverables, and responsible parties. Phases overlap in practice; the CxA manages the transitions.

Commissioning Objectives

The primary objectives of the commissioning process for this project are:

- Verify that the Owner's Project Requirements (OPR) are fully documented and used as the basis for design and construction decisions.
- Verify that the Basis of Design (BOD) addresses all OPR requirements and is maintained current through the project.
- Confirm that building systems are designed, installed, started up, and operated in accordance with the OPR and BOD.
- Provide documentation of system performance that serves as a baseline for ongoing operations.
- Identify and resolve deficiencies before the facility is occupied.
- Ensure that all Title 24 Acceptance Testing requirements are completed and documented.

- Transfer knowledge to the Owner's operations and maintenance (O&M) staff through documentation and training.

Project Overview

Located in Cabazon, California, the Morongo Casino Resort & Spa is a premier 27-story destination owned and operated by the Morongo Band of Cahuilla Mission Indians. As one of the largest tribal gaming and entertainment complexes in the western United States, the resort operates year-round with significant energy demands across gaming floors, hotel towers, restaurants, conference facilities, and back-of-house operations.

The Morongo CHP Phase 2 project introduces a fully integrated Combined Heat and Power system incorporating new 2.5 MW gas generators (CG1 and CG2), a 2MW/4MWh Battery Energy Storage System (BESS), upgraded thermal systems, and advanced power management controls. The project also includes modifications to the existing 12kV distribution system, connecting new switchgear GCP to existing switchgears SSE1 and CPS.

Phase 1 of the project connects the existing islanded power plant (CPS switchgear) to the existing 12kV SCE service (SSE1 switchgear) via a new 12kV feeder using existing spare breakers S2 and C10. The scope includes three sets of 500 KCMIL MV-105 cables in underground duct banks, a new SEL-751 feeder protection relay on breaker C10, non-export relay logic to prevent energy export to the SCE grid, breaker interlocking via SEL mirrored bits between SSE1 and CPS, PLC modifications at CPS for new C10 feeder I/O, a fiber optic communication link between CHP-1A and CPS, and a premanufactured utility bridge. Phase 1 commissioning is limited to Division 26 electrical systems.

Mechanical commissioning focuses on confirming the CHP plant's ability to supply Heating Hot Water and drive the Absorption Chiller for cooling while coordinating with the existing CMP plant. EMCS must manage all modes of operation seamlessly, including normal, outage, and demand-limiting conditions.

Field	Value
Project Name	Morongo CoGen
Project Address	Cabazon, California
Building Type	Casino Resort & Spa / CHP Power Plant
Construction Type	CHP Integration and Infrastructure Upgrade
Building Size	27-story destination resort
Authority Having Jurisdiction	Morongo Band of Cahuilla Mission Indians
Applicable Energy Code	2022 California Energy Code (Title-24 Part 6)
Design Documents	50% Construction Documents
Estimated Testing Duration	TBD
Estimated Completion	TBD

Commissioning Scope

The commissioning process will follow the applicable standards and codes:

- 2022 California Energy Code (Title-24 Part 6)
- 2022 California Green Buildings Standard - CALGreen (Title-24 Part 11)
- ACG Commissioning Guideline
- ASHRAE/IES Standard 202

Systems in Cx Scope

Phase 1

Division 26 - Electrical

- Electrical connections from SCE service SSE1 to switchgear CPS
- Non-export relay to prohibit energy export to the SCE grid
- Existing diesel generators (diesel back-up during power outage)
- Permissive interlock verification (S2, C10, C5, C11 breakers)
- SEL mirrored bits communication between SSE1 and CPS switchgear
- PLC I/O modifications and HMI screen updates for C10 feeder integration
- Sequence testing for all FDS operating modes (S1, S2, L, B1, B2, B3)

Phase 2

Division 22 - Plumbing

- Domestic and Industrial Cold-Water System (BFP, Water Hammer Arrestors, Trap Primers, Water Meters, Distribution Piping)
- Domestic Hot-Water System (Water Heaters, Circulation Pumps, Expansion Tanks, Thermostatic Mixing Valves)
- Natural Gas Distribution (Piping Walkdown)
- Compressed Air System (Air Compressors, Refrigerated Dryers, Air Receivers, Filters)
- Oily-Water Separator
- UREA Dosing Panel

Division 23 - HVAC & Controls

- Energy Management and Control System (ECMS) - PTP, SOO, Graphics, Trending, Alarming
- Chilled Water System (Absorption and Electric Chillers, Pumps, Refrigerant Monitor)
- Condenser Water System (Cooling Towers, Pumps, Filtration, Water Treatment)
- Heating Hot Water System (Boilers, Pumps, Deaerators, Heat Exchangers)

- DOAS Units (Economizer, Supply and Exhaust Fans)
- Hydronic Fan Coils
- Mufflers, Cooling Coil Units, DX Units
- Test, Adjust, & Balance (TAB) Verification

Division 25 - Integrated Automation

- Power Management System (PMS)
- Central Control System (CCS) / Utility Monitoring System

Division 26 - Electrical

- Gas Generators (CG1, CG2)
- Electrical Distribution (Singleline Walkdown, Power Study Verification)
- Substations, Switchboards/Switchgear, Distribution Panels, Transformers, Panelboards, Disconnects
- Electrical Metering and Submetering Systems
- Indoor Lighting Systems & Controls (20% Sampling)
- Lighting Inverter
- Outdoor Lighting Systems & Controls (20% Sampling)
- Battery Energy Storage System (BESS)

Systems Not in Cx Scope

The following systems are excluded unless amended by written agreement:

- Fire alarm and fire suppression systems (unless specifically added to scope)
- Building envelope (unless specifically added to scope)
- Elevators and vertical transportation
- Low-voltage systems (telecom, security, AV) unless integrated with BAS

Roles and Responsibilities

Commissioning Team

The Commissioning Team includes four major stakeholders: the Commissioning Authority, the Owner or Owner's Representative, the Architect and Engineer, and the General Contractors. Other commissioning team members can include construction managers, subcontractors, installers and vendors, and other specialty consultants.

Successful commissioning requires quality communication and collaboration between all parties in the construction process. This Commissioning Plan has been developed to assist in effective methods to communicate and collaborate.

GMC Cx must maintain continuous, open communication with the A/E team, sub-consultants, the General Contractor and subcontractors and the Owner's team.

All communications shall include the Owner or Owner's representative and any prime contractor or consultant.

No communication from GMC Cx to the project team shall be interpreted as direction that modifies the terms of any contract.

Commissioning Authority (GMC Commissioning, Inc.)

- Author and maintain the Commissioning Plan
- Review Basis of Design at each design phase and issue review comments
- Review submittals for commissioned equipment
- Develop and distribute Pre-Functional Checklists (PFC)
- Develop Functional Performance Test (FPT) protocols
- Conduct and document functional performance testing
- Maintain the Commissioning Issues Log
- Prepare systems manual per ASHRAE Guideline 0-2019
- Document Owner/operator training
- Prepare and issue the Final Commissioning Report
- Conduct warranty period review visit

Owner / Owner's Representative

- Participate in OPR development and approve the final OPR document
- Review and approve the Commissioning Plan at each major revision
- Designate a primary point of contact for Cx coordination
- Ensure O&M staff participate in training sessions
- Provide access and scheduling support for site visits and testing
- Make decisions on unresolved Cx issues within agreed response timeframes

Design Team (Architect and Engineers)

- Develop and maintain the Basis of Design throughout the project
- Respond to CxA design review comments within agreed timeframes
- Document complete sequences of operations for all BAS-controlled systems

- Incorporate commissioning requirements into contract documents
- Include Title 24 Acceptance Test form references in the construction documents
- Participate in commissioning coordination meetings during design phase
- Define load priority classifications per NEC Article 700/701/702 requirements and the owner's operational needs to determine which loads require 10-second restoration versus optional standby loads that can tolerate a longer restoration window

General Contractor

- Incorporate commissioning requirements into all subcontracts
- Schedule and coordinate Cx activities with the CxA and subcontractors
- Maintain a site-accessible commissioning documentation log
- Facilitate access for CxA site visits and functional testing
- Ensure subcontractors complete PFC checklists and startup documentation prior to FPT
- Track and manage Issues Log items assigned to the GC or subcontractors
- Plan and provide temporary generation (roll-up generators) required for site backup during Phase 1 and Phase 2 testing activities
- Verify with the owner the responsibility for procuring and providing temporary electrical load banks for generator commissioning testing
- Coordinate Phase 1 outage windows and temporary generator connections with the CxA, Electrical Contractor, and Controls Integrator to ensure adequate backup capacity is available at identified feeder connection points during each testing night

Mechanical Contractor

- Complete equipment installation per contract documents and manufacturer requirements
- Perform startup per manufacturer-published startup procedures
- Complete and submit PFC self-verification checklists to CxA
- Coordinate TAB contractor scheduling with CxA
- Participate in FPT and support re-testing as needed

Electrical Contractor

- Complete electrical installation per contract documents
- Program lighting controls per design intent and sequence of operations
- Complete Title 24 CF2R forms for applicable electrical and lighting systems
- Participate in functional testing of electrical and lighting control systems

Controls / BAS Contractor

- Program the BAS in accordance with the approved sequences of operations
- Coordinate with CxA on trend log setup and alarm configuration
- Provide BAS graphics and point-to-point verification documentation
- Participate in all BAS-related functional testing
- Support remote diagnostic review during warranty period

Testing, Adjusting, and Balancing (TAB) Contractor

- Perform TAB in accordance with NEBB, SMACNA, or AABC standards
- Submit a certified TAB report to the CxA and GC prior to FPT
- Coordinate with controls contractor for system verification and final balancing
- Participate in post-TAB functional testing as requested by the CxA

RACI Matrix

The RACI model is defined as follows:

Responsible (R): Responsible for completion of the activity.

Approves (A): Authority who approves document and support processes and/or system changes.

Contribute or Review (C): Supplies expertise necessary to complete the activity and may review information provided to them.

Informed (I): Notified of system status changes but not necessarily consulted.

Task	GMC Cx	Owner	A/E	GC
Owner's Project Requirements (OPR)	R	A	C	I
Basis of Design (BOD)	I	A	R	I
Commissioning Plan (CxP) & Specifications	R	A	C	C
Design Reviews & Protocols (PFC, PVT, FPT, IST)	R	A	C/A	I
Project Schedule & Submittals	C/I	C/I	A	R
Controls Coordination	R	A	C	C
Trend Data Collection & Review	A	I	I	R
Field Execution (PFC, PVT, FPT, IST)	A	I	I	R
Issues Log Management	A	I	C	R
O&M Manuals & Operator Training	C	A	A	R
Final Reports & Seasonal Testing	R	A	I	C
Post-Occupancy & Warranty Review	R	A	I	C

Monitoring-Based Commissioning (MBCx)

GMC Cx leverages SkySpark analytics software for monitoring-based commissioning (MBCx) including automated functional performance testing, fault detection and diagnostics (FDD), and BMS trend data analysis.

SkySpark will be provided, configured, and programmed in-house by GMC Commissioning. The General Contractor and Controls Contractor shall provide the necessary support for the coordination and installation of the SkySpark software, system integration and communication hardware, and BMS trending and data export configuration as directed by GMC Cx.

MBCx Plan

The Monitoring Based Commissioning (MBCx) plan will be issued as a separate document. The MBCx Plan documents the monitoring-based commissioning process, including SkySpark integration and use.

MBCx Implementation

To support a successful MBCx project it is critical to establish robust monitoring tools to support continuous energy and system analysis. This process goes far beyond simply installing hardware and software.

Performance Requirements / OPR / BOD

The Owner's Project Requirements (OPR) is the foundational document of the commissioning process. It defines the functional requirements, performance expectations, and operational goals for the project.

Basis of Design (BOD)

The BOD documents how the design team intends to meet each OPR requirement. It bridges the gap between what the owner wants and how the design delivers it.

System	Performance Requirements & Acceptance Criteria
CHP Gas Generators (CG1 & CG2)	• Full rated electrical output (~2.5 MW each) under normal and outage conditions • Non-export operation within 2 seconds per SCE interconnection requirements • Minimum 60% combined CHP efficiency (20% electrical + 20% thermal minimum) for ITC compliance • Parallel operation with SCE without instability or reverse power events • Island mode: start, ramp, and maintain parasitic loads when breakers G3/G4 open • Synchronization to diesel generators meets specified delay windows (≥15 s for inverter-based equipment, 60 s for synchronous stability)

Diesel Generators (EG5-EG8)	• Automatic start under outage conditions (EG8 for Casino Expansion; EG5-EG7 for Original Casino) • Support load shedding and load pickup per existing logic • Stable voltage/frequency before paralleling • Isolation within 1 second of utility reconnection during B1/B2 sequences • kW loading within nameplate limits during load recovery • **[FLAG FOR DISCUSSION] Transfer time criterion: Power Testing Scenarios document describes 10-30 second outage durations for diesel start sequences. Team to confirm acceptance criterion.**
PMS	• Automatic detection of utility under-voltage/outage; trigger Sequence S within designed timeframes • Safe island of campus, load shedding, diesel start, generator paralleling • Limit CHP export to SCE grid (export only up to PV generation) • Correct initiation of Sequences S, L, B1, B2, M1, M2, M3, T1-T3 • Load shedding correctly prioritized per 3-block priority programming • Closed-transition synchronization with utility after stability verification • PMS-to-EMCS communication triggers required modes (Economizer, Normal, etc.)
BESS (2MW/4MWh)	• Load leveling: charge during low load, discharge during peak • Minimum 25% state-of-charge reserved for emergency operation • Response to PMS charge/discharge commands during normal and outage conditions • SOC never falls below 25% during operational testing • Support generator stabilization during outage transitions
Domestic Hot Water	• DHW temperature at setpoint ±3°F for >90% of performance period • Enable logic per building schedule, lockout setpoints, downstream requests • Zero critical faults (equipment/component failures affecting operation)
Chilled Water System	• Design cooling capacity (tons) at specified conditions • CHWS temperature at setpoint ±5°F for >90% of performance period • System DP at setpoint ±2 psi for >90% of performance period • CW supply temp meets design approach to ambient wet bulb • Automatic sequencing to maintain 100% design load on single equipment failure • Absorption chiller: constant capacity when heat available; shutdown if CHW load insufficient • HHW priority: ACH cooling → SHW/DHW → pool heating • Temperature and pressure resets optimize per defined system variables
Heating Hot Water System	• HHWS temperature at setpoint ±5°F for >90% of performance period • System DP at setpoint ±2 psi for >90% of performance period • Temperature and pressure resets optimize per defined system variables

DOAS Units	• SAT at setpoint ±5°F for >90% of performance period • Supply duct static pressure at setpoint ±0.2" w.c. for >90% • Return airflow at setpoint ±5% for >90% • Outside airflow at or above minimum for >95%
Terminal Units (VAVs, Fan Coils)	• Zone temp at setpoint ±2°F for >90% of performance period • Zone temp meets setpoint within 1 hour of initial command • Zone CO2 at setpoint +100 PPM for >90%

Design Reviews

GMC Cx will review the design documents at each design milestone to verify the design team's work is consistent with the OPR. Reviews are performed at the schematic, design development, and construction document phases.

Focus Areas

- Compliance with the OPR and BOD
- Adequate specification of commissioning requirements in Divisions 01, 22, 23, 25, and 26
- Sequence of operations clarity and completeness
- Controls drawings and points lists
- Equipment schedules and capacity verification
- Title 24 compliance requirements
- CHP system integration with existing campus infrastructure
- 12kV distribution and generation system coordination
- PMS integration with EMCS and existing diesel generators

Controls Coordination

Controls coordination is critical for this project given the complexity of the PMS, EMCS, and CHP integration. GMC Cx will facilitate controls coordination meetings to establish clear communication between the controls contractor, PMS vendor, and mechanical contractor.

Key controls coordination activities include:

- Review and verify the Sequence of Operations for all BAS/EMCS-controlled systems
- Coordinate PMS-to-EMCS communication protocols and data exchange requirements
- Verify BAS point naming conventions and trend log configuration
- Review controls submittals for completeness and alignment with contract documents
- Coordinate alarm priorities and notification logic across PMS and EMCS

- Establish trending and data logging requirements for MBCx
- Review controls contractor's PTP checkout methodology prior to execution
- Coordinate 12kV switchgear control integration with PMS vendor (Wonderware)

Submittal Reviews

GMC Cx will review equipment submittals for systems in the commissioning scope to verify that submitted equipment meets the design intent and OPR requirements. Submittals will be reviewed for compliance with contract documents and performance specifications.

The review focuses on:

- Equipment capacity and performance data compared to design schedules
- Electrical characteristics (voltage, phase, MCA, MOCP)
- Controls integration capability and communication protocols
- Physical dimensions and installation requirements
- Manufacturer warranty terms
- Compliance with applicable codes and standards

Schedule Coordination

GMC Cx will coordinate commissioning activities with the construction schedule. The GC shall provide a construction schedule that includes commissioning milestones. GMC Cx will work with the GC to integrate commissioning activities into the project schedule.

Key Commissioning Milestones

- Commissioning kickoff meeting
- Design review milestones (SD, DD, CD, IFC)
- Submittal review periods
- Controls coordination meetings
- PFC execution readiness
- Startup witness scheduling
- TAB verification scheduling
- FPT execution windows
- IST (Blackout Test) scheduling
- Temporary load bank testing periods
- Owner training sessions

- Final report delivery

Site Observation Reports (SOR)

GMC Cx will conduct periodic site visits to observe construction progress and verify that commissioned systems are being installed in accordance with the contract documents. Observations will be documented in Site Observation Reports (SOR) and distributed to the project team.

Site observations will focus on:

- Equipment installation quality and accessibility for maintenance
- Ductwork, piping, and electrical installation per contract documents
- Controls device locations and sensor placement
- Equipment nameplate verification
- Insulation and sealing
- Safety and code compliance items

Protocol Development

GMC Cx will develop commissioning protocols (PFC, PVT, FPT, IST) for all systems in the commissioning scope. Protocols will be developed based on the approved contract documents, equipment submittals, and manufacturer requirements.

Protocols will be distributed to the project team for review and comment prior to execution. The A/E team will review protocols for technical accuracy, and the GC will review for scheduling and logistics.

Pre-Functional Checklists (PFC)

Pre-Functional Checklists are installation verification documents that confirm equipment has been properly installed, connected, and is ready for startup and functional testing. PFCs are completed by the installing contractor and reviewed by GMC Cx.

PFCs will be developed in Cx Planner and distributed to the installing contractors. The GC shall coordinate PFC completion and notify GMC Cx when equipment is ready for review.

Pre-Verification Test (PVT)

Pre-Verification Tests are startup-level tests completed by the installing contractor to verify that equipment operates correctly before functional testing. PVTs confirm basic functionality such as rotation direction, setpoint response, and safety device operation.

The installing contractor shall complete PVTs and submit results to GMC Cx prior to scheduling functional performance testing.

TAB Review and Verification

GMC Cx will review the TAB report and note any discrepancies. The EOR shall review and approve the TAB report. The general contractor shall provide the TAB report for review.

GMC Cx will schedule TAB verification based on GC input. GMC Cx will document any deviations from the design documents and TAB report.

The TAB and Controls contractors shall verify, with GMC Cx as a witness, that sampled temperature, pressure, and flow measuring components are measured and accurate compared to the design documents and TAB report.

Contractor support required: Dedicated representatives from the GC, MC, TAB, CC for the duration of the test.

Estimated Testing Duration: 4-8 hours

Trend Review

The verification of a properly functioning system requires multi-day trending of critical control points to confirm operation schedules, setpoint control, proper loop tuning, and no excessive cycling or alarming.

The controls contractor, and other vendors providing systems with the ability to trend operational data, shall send 7-day trends of specified and requested data points in Excel CSV format to GMC Cx prior to scheduling FPTs.

Functional Performance Tests (FPT)

Functional Performance Tests dictate a step-by-step script to be followed. Each step outlines the action required, expected results, and pass/fail acceptance criteria. The installing contractor must provide a fully dedicated technician, vendor, and/or manufacturer representative intimately familiar with the installed system(s) to perform the procedures outlined in the FPT protocols.

Testing Support

GMC Cx uses quality-based, statistical sampling techniques. ASHRAE Guideline 0 recommends a sampling rate between 3% and 100%. Planned initial sample size is indicated for each system. During inspections, if more than 10% of sampled units show the same or similar defect, a second sample will be implemented.

All tools, test equipment and measurement devices required for verification shall be provided by the installing contractor. All measuring devices shall be calibrated, within their calibrated period, and have calibration stickers current and visible on the device.

Non-Conformance and Retesting

The Contractor shall retest the equipment until all deficiencies have been resolved and notify the CxA that the deficiency has been corrected. The CxA will witness retesting at their discretion based on the deficiency.

Testing Sequence

Following a proper sequence during PFCs and FPTs is imperative to ensure a smooth, comprehensive commissioning process. The ideal sequence of testing events is:

- PTP Checkout (By Contractor)
- TAB (By Contractor)
- Documentation Review (PTP report, preliminary TAB report)
- TAB Verification (airflow proportional balance, pump flow, sensor verifications)
- System Level FPTs (ECMS/PMS: sensors, PTP, graphics, alarms, sequences, trending)
- Equipment Level FPTs
- SkySpark Automated Testing (AutoFPTs)
- 7-to-14-day Performance Period Review
- IST (Blackout Test / Load Bank Testing)

The following documentation is required to be submitted for CxA review prior to scheduling functional testing:

- DALT Report
- Flushing Reports
- Startup Reports
- PTP Checkout
- 7-Day Trends and Alarms
- TAB Report
- MEP Acceptance Test Reports
- Power Study
- NETA Tests
- Coordination and Arc Flash Study
- Finalized Phase 1 Sequence of Operations (SOO)
- FAT Report for Phase 1 Control System Modifications
- Completed PVTs by the installing contractor

Testing Plan

Division 22 - Plumbing

Domestic and Industrial Cold Water Systems

Pre-requisite Contractor Provided Documentation: Pipe Pressure Test Report, Sanitization/Disinfection/Chlorination Report, Backflow Preventer Certification.

Witness Sample Rate: 100% Equipment, 10% Distribution

Testing Procedure: The installing contractors shall demonstrate operation of backflow preventers, water meters, and pressure reducing valves. GMC Cx will witness temperature, pressure and flow at points of use as well as verify compliance with the contract documents.

Onsite Contractor Support Required: Dedicated representatives from the GC and PC for the duration of the test.

Contractor Provided Tools and Test Equipment: Pressure gauge, temperature sensor, flow meter.

Estimated Minimum Testing Duration: Minimum 8 hr.

Domestic and Industrial Hot Water Systems

Pre-requisite Contractor Provided Documentation: Pipe Pressure Test Report, Sanitization/Disinfection/Chlorination Report, Water Heater Startup Report.

Witness Sample Rate: 100% Generation, 10% Distribution

Testing Procedure: The installing contractors shall demonstrate operation of hot water heaters, pumps and controls. Domestic water heaters will be tested for proper ignition, temperature control, and safety shutdown functionality.

Onsite Contractor Support Required: Dedicated representatives from the GC and PC for the duration of the test.

Contractor Provided Tools and Test Equipment: Pressure gauge, temperature sensor, flow meter.

Estimated Minimum Testing Duration: Minimum 8 hr.

Natural Gas Distribution

Pre-requisite Contractor Provided Documentation: Pipe Pressure Test Report.

Witness Sample Rate: 100% Equipment, 10% Distribution

Testing Procedure: The natural gas distribution system will be tested to confirm proper installation, leak-free performance, and compliance with project specifications and local code requirements.

Onsite Contractor Support Required: Dedicated representatives from the GC and PC for the duration of the test.

Contractor Provided Tools and Test Equipment: Pressure gauge, temperature sensor, flow meter.

Estimated Minimum Testing Duration: Minimum 4 hr.

Compressed Dry Air System

Pre-requisite Contractor Provided Documentation: Pipe Pressure Test Report, Startup Report, Air Purity Test Report.

Witness Sample Rate: 100% Generation, 10% Distribution

Testing Procedure: The installing contractors shall demonstrate operation of the CDA system including air compressor(s) stage or modulate to maintain discharge pressure at specified setpoint. The installing contractors shall demonstrate operation of the refrigerated dryers, oil separators, and filtration systems.

Onsite Contractor Support Required: Dedicated representatives from the GC, Vendor and PC for the duration of the test.

Contractor Provided Tools and Test Equipment: Pressure gauge, Dew Point Sensor.

Estimated Minimum Testing Duration: Minimum 2 hr.

Plumbing - Other (Demand Flow Controller, Oily-Water Separator, UREA Dosing Panel)

Pre-requisite Contractor Provided Documentation: Gas Quality Testing Report.

Witness Sample Rate: 100% Generation, 10% Distribution

Testing Procedure: Commissioning will verify the proper installation and operation of the demand flow controller, oily-water separator, and UREA dosing panel. Functional testing will confirm that each system operates correctly including proper sensor readings, alarm functions, and automated controls.

Onsite Contractor Support Required: Dedicated representatives from the GC, Vendor and PC for the duration of the test.

Contractor Provided Tools and Test Equipment: Pressure gauge.

Estimated Minimum Testing Duration: Minimum 4 hr.

Division 23 - Heating, Ventilating and Air Conditioning

Energy Control and Monitoring System (ECMS)

Pre-requisite Contractor Provided Documentation: Point to Point Checkout, Approved Graphics Submittal.

Witness Sample Rate: 20% Equipment, 100% Sequences, 20% Sensors, 20% PTP

Testing Procedure: The ECMS vendor shall demonstrate operation of the ECMS system. GMC Cx will verify completion and accuracy of graphics, communication stability, local and remote alarms, trend logging and storage, and general system operation. General functional testing procedures for all connected equipment will include control system point-to-point verification, sequence of operations verifications, system alarms and sequencing, and performance period review. The ECMS vendor is responsible to provide calibrated tools to confirm accuracy of controls transmitters.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC for the duration of the test.

Contractor Provided Tools and Test Equipment: Hydronic and air DP meters.

Estimated Minimum Testing Duration: Minimum 8 hr.

Chilled Water and Condenser Water System

Pre-requisite Contractor Provided Documentation: Pipe Pressure and Flushing Reports, Startup Reports, TAB Reports.

Witness Sample Rate: 100% Generation, 10% Distribution

Testing Procedure: The installing contractor shall demonstrate the sequence of operation of the chiller and condenser water system by testing the modes of operation including startup and shutdown, setpoint control, lead/lag switching, failure modes, and operating mode transitions. System scenario testing will include plant enable/disable, normal mode (CMP-MODE = 0), power outage mode (CMP-MODE = 1), demand limiting mode (CMP-MODE = 2), mode transitions, HRSG or steam system failure, chiller failure, CHW pump VFD failure, CW pump VFD failure, and cooling tower fan VFD failure.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician). TAB contractor for TAB verification.

Contractor Provided Tools and Test Equipment: Hydronic DP meter, Flow Meter, temperature probe.

Estimated Minimum Testing Duration: Minimum 32 hr.

Heating Hot Water System

Pre-requisite Contractor Provided Documentation: Pipe Pressure and Flushing Reports, Startup Reports, TAB Reports.

Witness Sample Rate: 100% Generation, 10% Distribution

Testing Procedure: The installing contractor shall demonstrate the sequence of operation of the heating hot water system by testing the modes of operation including startup and shutdown, setpoint control, lead/lag switching, and failure scenarios. Functional testing of the water-to-water heat exchangers will verify their ability to transfer heat effectively and maintain design temperatures and flow rates.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician). TAB contractor for TAB verification.

Contractor Provided Tools and Test Equipment: Hydronic DP meter, Flow Meter, temperature probe.

Estimated Minimum Testing Duration: Minimum 8 hr.

Air Handling (DOAS) Units

Pre-requisite Contractor Provided Documentation: Startup Report, TAB Report.

Witness Sample Rate: 100%

Testing Procedure: The installing contractor shall demonstrate the sequence of operation of the air handlers by testing the modes of operation including startup and shutdown, setpoint control, fan failure, high static, and smoke detector shutdown. Smoke detector shutdown shall be demonstrated by the mechanical or fire alarm contractor.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician). TAB contractor for TAB verification.

Contractor Provided Tools and Test Equipment: Air DP meter / Magnehelic with high/low pressure max reading.

Estimated Minimum Testing Duration: Minimum 2 hr. per unit

Combustion Gas Generators (CG1 & CG2)

Pre-requisite Contractor Provided Documentation: Startup Report.

Witness Sample Rate: 100%

Testing Procedure: The functional testing of the natural gas engine generators will confirm their ability to start, synchronize, and operate safely and reliably in accordance with the project's design and performance requirements. System scenario testing will include plant enable/disable, plant startup/shutdown, generator load rejection, loss of fuel supply, cooling water pump failure, control system failover, generator automatic start on loss of power. See Appendix 2 for 12kV Distribution and Generation Testing Scenarios.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician).

Contractor Provided Tools and Test Equipment: Power quality meter.

Estimated Minimum Testing Duration: Minimum 32 hrs.

General Exhaust Fans, Supply Fans and Transfer Fans

Pre-requisite Contractor Provided Documentation: Startup Report, TAB Report.

Witness Sample Rate: 100%

Testing Procedure: The installing contractor shall demonstrate the sequence of operation of the fans by testing the modes of operation including startup and shutdown, setpoint control, and fan failure.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician). TAB contractor for TAB verification.

Contractor Provided Tools and Test Equipment: Air DP meter / Magnehelic with high/low pressure max reading.

Estimated Minimum Testing Duration: Minimum 30min per unit

Hydronic and DX Fan Coil Units

Pre-requisite Contractor Provided Documentation: Startup Report, TAB Report.

Witness Sample Rate: 100%

Testing Procedure: The installing contractor shall demonstrate the sequence of operation of the fan coil units by testing the modes of operation including startup and shutdown, setpoint control, and fan failure as applicable. Smoke detector shutdown shall be demonstrated by the mechanical or fire alarm contractor.

Onsite Contractor Support Required: Dedicated representatives from the GC, Controls Vendor and MC (startup technician). TAB contractor for TAB verification.

Contractor Provided Tools and Test Equipment: Air DP meter.

Estimated Minimum Testing Duration: Minimum 1 hr. per unit

Division 25 - Integrated Automation

Power Management System (PMS)

Pre-requisite Contractor Provided Documentation: PMS Startup Report, NETA Tests, Power Study.

Witness Sample Rate: 100%

Testing Procedure: GMC Cx will verify the proper installation, configuration, and integration of the Power Management System (PMS), including power meters, control panels, network communication devices, and associated software. The functional testing of the PMS using Wonderware will verify its capability to effectively manage power generation and distribution with a focus on 12kV grid management, synchronization, load management and utility interaction. The PMS interface with the EMCS system will be validated. System scenario testing includes paralleling switchgear functional testing, synchronizing control system testing, load management testing, utility interaction and export control testing, and protective relaying functional tests. See Appendix 2 for 12kV Distribution and Generation Testing Scenarios.

[FLAG FOR DISCUSSION] discrepancy between the FDS and ELEN testing scenarios that needs to get resolved. The FDS describes the gas-to-SCE switchover (opening C5 and closing C10) as a manual breaker operation with a short outage. ELEN Test 1A assumes this is automatic, with controls opening C5 and closing C10. Which is correct?

Onsite Contractor Support Required: Dedicated representatives from the GC, PMS Vendor.

Contractor Provided Tools and Test Equipment: Power quality meter.

Estimated Minimum Testing Duration: Minimum 16 hr.

Division 26 - Electrical

Electrical Switchgear, Substations, Distribution Boards and Panelboards

Pre-requisite Contractor Provided Documentation: Power System Study, NETA Test Report, Megger Test Report, As-Built Electrical Drawings, For Record Singleline.

Witness Sample Rate: 100% Critical, 10% Other

Testing Procedure: All work to be performed with LOTO de-energized gear if exposed or final, safe installation with no exposed energized electrical components. GMC Cx will verify nameplate data, panel labelling, arc flash sticker, and panel schedules are installed as per contract documents. The installing contractor shall demonstrate that NETA testing has been completed per contract documents and adjustable trip breaker settings are field set per the approved short circuit coordination study.

Onsite Contractor Support Required: Dedicated representatives from the GC and EC for the duration of the test.

Contractor Provided Tools and Test Equipment: None.

Estimated Minimum Testing Duration: 30min-1 hr. per equipment

Electrical Transformers

Pre-requisite Contractor Provided Documentation: Power System Study, NETA Test Report, Megger Test Report, As-Built Electrical Drawings, For Record Singleline.

Witness Sample Rate: 100% Critical, 10% Other

Testing Procedure: All work to be performed with LOTO de-energized gear if exposed. GMC Cx will verify nameplate data, labelling and arc flash sticker are installed as per contract documents. The installing contractor shall demonstrate NETA testing has been completed per contract documents, mechanical cooling systems and controls operate if applicable, and tap configuration and grounding per approved documents.

Onsite Contractor Support Required: Dedicated representatives from the GC and EC for the duration of the test.

Contractor Provided Tools and Test Equipment: None.

Estimated Minimum Testing Duration: 30min-1 hr. per equipment

Motor Starters and Disconnects

Pre-requisite Contractor Provided Documentation: Power System Study, NETA Test Report, As-Built Electrical Drawings.

Witness Sample Rate: 100% Critical, 10% Other

Testing Procedure: GMC Cx will verify nameplate data, labelling and arc flash sticker are installed as per contract documents. The installing contractor shall demonstrate switch operation and Hand-Off-Auto (HOA) operation. The installing contractor shall verify fuse sizing matches contract documents.

Onsite Contractor Support Required: Dedicated representatives from the GC and EC for the duration of the test.

Contractor Provided Tools and Test Equipment: None.

Estimated Minimum Testing Duration: 10 min. per equipment

Lighting System and Controls

Pre-requisite Contractor Provided Documentation: As-Built Lighting drawings.

Witness Sample Rate: 20%

Testing Procedure: GMC Cx will verify fixtures, switches, sensors and controls are installed per contract documents. The installing contractor or vendor shall demonstrate functionality of lighting control system including occupancy/vacancy sensors, photocells and dimming controls, system schedules, switches and overrides.

Onsite Contractor Support Required: Dedicated representatives from the GC, lighting controls vendor and EC for the duration of the test.

Contractor Provided Tools and Test Equipment: None.

Estimated Minimum Testing Duration: Minimum 2 hr.

Lighting Inverters

Pre-requisite Contractor Provided Documentation: As-Built Lighting drawings.

Witness Sample Rate: 20%

Testing Procedure: GMC Cx will verify equipment and controls are installed per contract documents. The installing contractor or vendor shall demonstrate functionality of the inverter by testing inverter operation through the simulated loss of utility power. Vendor shall conduct battery drain down test.

Onsite Contractor Support Required: Dedicated representatives from the GC, lighting controls vendor and EC.

Contractor Provided Tools and Test Equipment: Load bank if required.

Estimated Minimum Testing Duration: Minimum 1 hr.

Power Meters

Pre-requisite Contractor Provided Documentation: As-Built Electrical Drawings, For Record Singleline.

Witness Sample Rate: 100% Critical, 10% Other

Testing Procedure: GMC Cx will verify equipment and wiring are installed per contract documents pre-energization. The installing contractor shall demonstrate functionality and confirm meter accuracy with Power Quality Meters (PQM). Contractor shall utilize load banks to simulate various load conditions.

Onsite Contractor Support Required: Dedicated representatives from the GC and EC.

Contractor Provided Tools and Test Equipment: Load bank with capacity matching the power meter and a power quality meter for verification.

Estimated Minimum Testing Duration: Minimum 1 hr.

Uninterruptible Power Supplies (UPS)

Pre-requisite Contractor Provided Documentation: As-Built Electrical Drawings, For Record Singleline.

Witness Sample Rate: 100%

Testing Procedure: GMC Cx will verify equipment and wiring are installed per contract documents pre-energization. The installing contractor or vendor shall demonstrate system functionality and confirm operation via a load bank test with Power Quality Metering (PQM) report. Vendor shall conduct battery drain down test.

Onsite Contractor Support Required: Dedicated representatives from the GC, UPS Vendor and EC.

Contractor Provided Tools and Test Equipment: Load bank with capacity matching the UPS capacity and a power quality meter for verification.

Estimated Minimum Testing Duration: Minimum 2 hr.

Battery Energy Storage System (BESS)

Pre-requisite Contractor Provided Documentation: As-Built Electrical Drawings, For Record Singleline.

Witness Sample Rate: 100%

Testing Procedure: GMC Cx will verify equipment and wiring are installed per contract documents pre-energization. The installing contractor shall demonstrate functionality and confirm meter accuracy with Power Quality Meters (PQM). Testing will include charge/discharge cycles, inverter response, ramp rates, PMS integration, SOC monitoring, and emergency reserve verification.

Onsite Contractor Support Required: Dedicated representatives from the GC, BESS Vendor and EC.

Contractor Provided Tools and Test Equipment: Load bank with capacity matching the power meter and a power quality meter for verification.

Estimated Minimum Testing Duration: Minimum 4 hr.

Integrated System Tests (IST)

ISTs will be executed by the associated contractor and witnessed by GMC Commissioning. The installing contractor must provide a fully dedicated technician, vendor, and/or manufacturer representative intimately familiar with the installed system(s) for the duration of the test.

The following is required prior to scheduling IST testing:

- PFCs Complete
- FPTs Complete
- No outstanding issues related to any system involved with the IST

Power Loss and Restoration Test (Blackout / Black Start Test)

The Power Loss and Restoration (Blackout / Black Start) Test will be conducted to verify the ability of the CHP and diesel generation systems to safely and reliably respond to a complete loss of utility power. The test will verify automatic startup of diesel generators, load shedding sequences, PMS control logic, and restoration of normal power.

The test will also verify that essential mechanical, process, and control systems respond appropriately during the outage, including protection, shutdown, hold, or continued operation of all commissioned systems.

Phase 1 includes its own sequence testing independent of the Phase 2 IST. The Phase 1 functional tests verify 12kV distribution transfer sequences (S1, S2, L, B1, B2, B3), permissive interlocks, gas generator failure scenarios, and return-to-utility procedures as defined in the FDS and the Phase 1 Testing Plan (Appendix 1). The full CHP blackout and black start IST, including new gas generators, BESS, and thermal system integration, is a Phase 2 activity and will be conducted after Phase 2 commissioning is complete.

See Appendix 2 for 12kV Distribution and Generation Testing Scenarios.

Contractor support required: Electrical Contractor shall provide assistance with main breaker operation. Controls will monitor and provide access to the EMCS. General Contractor will provide access, general assistance and oversite.

Estimated Testing Duration: Minimum 16 hr.

Temporary Load Testing Plan

Temporary electrical and thermal load banks will be used during commissioning to validate the performance, stability, protection functions, and heat-recovery characteristics of the generating assets at the Morongo CHP facility. Load bank requirements differ between Phase 1 and Phase 2 as described below. All load banks, cables, and associated testing equipment shall be provided by the General Contractor.

Phase 1

Phase 1 commissioning will follow a two-stage testing approach. The first stage verifies sequence logic and permissive interlocks with no connected load on the CPS bus. This confirms programming and interlock wiring without risk to campus operations. The second stage validates functional performance with load on the CPS bus to prove transfer sequences, load shedding, and diesel generator response under operating conditions.

[FLAG FOR DISCUSSION] Load banks may be required for Phase 1 testing. Phase 1 functional tests may be conducted with actual campus load on the CPS bus. However, if the final testing procedure requires a minimum bus loading threshold that cannot be met with campus load alone, the GC shall provide and connect a load bank at a connection point to be coordinated with the Controls Integrator and CxA. Load bank sizing and connection details, if required, will be defined in an updated Phase 1 Testing Plan (Appendix 1).

Phase 2

Electrical load banks will be required for Phase 2 CHP generator commissioning. A minimum 3MW resistive/reactive load bank with 0.8 power factor capability will be connected at the designated load bank connection point at GCP per the E-601 testing configuration. Load bank sizing is subject to change as the testing procedure develops. Electrical load banks will be sized to approximate the full nameplate rating of each generator being commissioned to allow full-load testing of CG1 and CG2 without affecting casino operations.

Thermal load testing will be performed where required to validate CHP system performance and heat-recovery functionality.

Load bank testing will also be applied to BESS to validate charge/discharge performance, inverter response, ramp rates, and interactions with the PMS.

The GC should verify with the owner the responsibility for procuring and providing load banks. All temporary load tests will be coordinated with the PMS, EMCS, and switchgear manufacturers to ensure safe operation, proper interlock verification, and correct data capture during testing.

Temporary Generator Requirements

Roll-up temporary generators will be required for site backup during both Phase 1 and Phase 2 testing activities. During testing sequences that require isolation of existing generators from campus loads, temporary generation provides backup power to maintain facility operations. All generators, cables, and associated testing equipment shall be provided by the General Contractor. GMC Cx does not provide testing equipment. The GC shall coordinate generator sizing, placement, fuel supply, and connection points with the Electrical Contractor, Controls Integrator, and CxA.

Phase 1

Temporary generators will be required for campus backup during Phase 1 sequence testing. When the CPS bus is de-energized or isolated for testing, temporary generation provides backup power to maintain operations on affected feeders. The Phase 1 Testing Plan (Appendix 1) defines specific outage windows and testing sequences. The plan requests three consecutive outage nights (3:00 AM to 9:00 AM) to condense functional testing into a single trip, with the third night reserved as contingency.

Connection points for temporary generation at existing CPS feeders have been identified from previous site outage experience:

- F1 feeder: Requires two 2MW generators in parallel at 12kV using spare 12kV switches. This feeder carries the heaviest casino loads with peak demand approaching 3.5 to 4MW due to gaming machine UPS recharge inrush after power restoration.
- F2 feeder: Lightly loaded (security cameras, cash cages). A 480V breaker was previously installed in the MCC after the F2 transformer during a past outage and may still be in place. GC to field-verify.
- F3 feeder: Previously served by both 12kV roll-up (via L1 switch) and 480V secondary-side connection. A 480V breaker may still be installed from the last outage. GC to field-verify.

The CxA and Controls Integrator shall confirm the minimum CPS bus loading required for valid sequence testing before the temporary generator plan is finalized. Transferring all feeder loads to temporary generators may reduce bus loading below what is needed to validate load shedding, transfer timing, and diesel generator response under realistic conditions.

EG8 (3MW diesel generator at SSE1) must be confirmed operational before Phase 1 functional testing. All return-to-utility sequences (B1, B2, B3) depend on EG8 to synchronize with utility power and close breaker S1. EG8 is not in GMC Cx direct scope but is a prerequisite for Phase 1 sequence testing.

CHP generator and existing diesel generator manufacturer representatives shall be on-site during Phase 1 functional testing to support troubleshooting and confirm equipment protection settings.

Phase 2

Temporary generation will be required during Phase 2 to maintain power to CHP facility loads while existing and new generators are isolated for commissioning testing. The GC shall provide roll-up generator(s) sized for the MSB switchboard calculated load. Generator sizing is to be confirmed by the MEP Engineer based on the MSB design.

The E-601 testing configuration drawing identifies connection points, breaker positions, and equipment coordination requirements for Phase 2 testing. All generators, load banks, cables, and associated testing equipment shall be provided by the General Contractor. Coordination of equipment and personnel during testing is the responsibility of the GC.

Detailed Phase 2 temporary generation requirements will be defined as the Phase 2 design progresses. A Phase 2 Testing Plan will be developed by GMC Cx that identifies specific testing sequences, outage windows, and temporary generation needs for gas generator installation and integration testing.

Issues Log - Deficiency Reporting & Resolution

An issues log serves several purposes including communicating problems found during commissioning, tracking issue status, documenting issue dialog among team members, identifying areas of concern, and maintaining a historical record.

Commissioning issues that are identified during construction will be tracked by the CxA in the Issues Log in Cx Planner.

Issues will be created by GMC Cx and assigned to a responsible party. The issue will be given a due date of two weeks from the date the issue is found. The responsible party is to provide a response within that timeframe.

The following is a guide to the issue status:

Open: Open issues to be addressed by the assigned party.

Work Complete: The issue has been resolved by the responsible party and photo evidence of the remedy is uploaded along with a description of the resolution.

Pending Approval: Issues that the assigned contractor does not believe is an issue or an issue that requires re-assignment to another party.

In Review: Issues that may be change orders or require external input.

Closed: Issues that have been backchecked and confirmed to be closed.

Deferred: Issues that are not immediately relevant and can be postponed for a later time.

Observation: Items of note that are not issues.

Recommendation: Issues or suggestions that are outside of contract documents.

Issue priorities will be identified at creation with the following meanings:

Critical: Issue affects Life Safety.

High: Issue affects system or equipment operation to the point that Cx testing cannot proceed.

Medium: Operation, energy, or performance impact which does not affect the primary intent of system or equipment.

Low: Issue has minimal impact on system or equipment operation.

Owner/Operator Training

Owner training is critical in the turnover of the new CHP plant systems. Successful training begins with understanding the specific needs of the facility team and determining the appropriate scope and level of training.

The training sessions should include a clear and comprehensive breakdown of the new MEP and building controls systems, along with identifying equipment locations, pointing out potential safety concerns, and demonstrating the systems in operation.

Confirmation that all training meets the scope of the owner's requirements shall include:

- Copies of the training handouts/materials utilized in the training
- Copies of all training syllabi
- Copies of attendance sign-in sheets

Training Plan

Training Session	Systems Covered	Audience	Est. Duration	Delivered By	Date
CHP Plant Operations	Gas generators, BESS, PMS, switchgear	O&M Staff, Plant Operators	8 hrs	Vendor + CxA	TBD
HVAC Systems Overview	DOAS, fan coils, CHW/HHW systems	O&M Staff, Facilities Mgr.	4 hrs	MC + CxA	TBD
BAS/EMCS Operations	Graphics, setpoints, alarms, trends	O&M Staff, IT	8 hrs	Controls + CxA	TBD
Chiller and Boiler Plant	Absorption chiller, cooling towers, HHW	O&M Staff	8 hrs	MC	TBD
Electrical Distribution	12kV switchgear, transformers, metering	O&M Staff, Electrician	2 hrs	EC + CxA	TBD
Emergency Power Systems	Diesel generators, BESS, PMS sequences	O&M Staff, Facilities Mgr.	4 hrs	EC + Vendor	TBD
Lighting Controls	Sensors, daylight controls, schedules	O&M, Electrician	1.5 hrs	EC + CxA	TBD
Plumbing Systems	DHW, CDA, natural gas, UREA dosing	O&M Staff	1 hr	PC	TBD
Cx Documentation	Systems manual walkthrough, O&M reference	Facilities Mgr., O&M	1 hr	CxA	TBD

Systems Manual, CFR, O&M Plan and Ongoing Cx Plan

The Current Facilities Requirements (CFR), Operations and Maintenance (O&M) plan and Systems Manual include information about the commissioned systems and equipment. The

Ongoing Commissioning (OCx) process and plan is included as a chapter within the Systems Manual.

GMC Cx will establish an ongoing commissioning process and plan that includes planning, point monitoring, system testing, performance verification, corrective action response, ongoing measurement, and documentation.

Systems Manual Minimum Content

Section	Content Description
1	Project description, building purpose, occupancy schedule, design intent summary
2	Owner's Project Requirements -- final approved version
3	Final Basis of Design or reference to design team-maintained BOD
4	Narrative description of each commissioned system -- purpose, major components, design capacity, operating ranges
5	Final approved Sequence of Operations for all BAS-controlled systems
6	All control setpoints, differential pressure setpoints, temperature reset schedules, occupied/unoccupied settings
7	Nameplate data, model numbers, serial numbers, suppliers, and warranty expiration for all major commissioned equipment
8	Normal startup and shutdown; seasonal changeover; emergency operation; manual override procedures
9	Recommended PM intervals for all commissioned equipment
10	Recommended frequency and scope for recommissioning; key performance indicators to monitor
11	BAS trend parameters, baseline performance data, deviation thresholds, escalation procedures
12	Training agenda, date, attendees, systems covered, reference to recordings or materials
13	Equipment warranty terms, warranty contacts, and warranty expiration dates

Final Commissioning Report

The final commissioning report is the last major deliverable from the CxA during the construction phase. This report starts with an executive summary indicating the highlighted project information, results, and findings of the commissioning process.

The final commissioning report will be delivered by substantial completion and provided to the owner in PDF format unless otherwise requested at the end of construction.

The Final Commissioning Report will include:

- Finalized Commissioning Plan
- Final Commissioning Issues Log

- Commissioning Lessons Learned and Project Highlights
- Completed Cx Protocols
- Commissioning Site Observation Reports
- Commissioning Meeting Minutes
- Design and Submittal Review Comments

Warranty Phase Activities

Seasonal Testing (Deferred Testing)

Certain system sequences cannot be fully verified during the initial testing phase due to ambient weather conditions. The CxA will coordinate with the Owner and Contractor to schedule deferred testing during the first peak cooling or peak heating season following occupancy. Results from seasonal testing will be documented as an addendum to the Final Commissioning Report.

The 10-Month Warranty Review

The in-warranty review will be scheduled approximately 8-10 months after substantial completion of construction, prior to system/equipment warranties expiring. This review involves the entire Cx team and will focus on:

- Evaluate system performance under actual building loads and occupancy schedules
- Identify latent deficiencies not apparent during initial functional testing
- Support operations staff in addressing nuisance alarms, comfort complaints, or operational challenges
- Verify that corrective actions from the Final Commissioning Report have been addressed

In addition to warranty related equipment walkdowns, the CxA will review building energy performance through BAS trend data and owner provided utility bills.

Appendix 1 – Phase 1 Test Plan

#	Verification Item	Description / What to Verify	Responsible Party	Notes
EXISTING BREAKER VERIFICATION (S2 at SSE1, C10 at CPS)				
1	S2 breaker mechanical operation check	Verify S2 rack-in/rack-out, spring charging motor, trip/close mechanism, position indicators		
2	S2 breaker insulation resistance test	Megger S2 poles phase-to-phase and phase-to-ground. Compare against manufacturer minimum		
3	S2 breaker contact resistance test	Micro-ohm test across S2 main contacts. Compare against manufacturer baseline		
4	S2 breaker trip/close timing test	Verify S2 trip and close times within manufacturer spec using breaker analyzer		
5	C10 breaker mechanical operation check	Verify C10 rack-in/rack-out, spring charging motor, trip/close mechanism, position indicators		
6	C10 breaker insulation resistance test	Megger C10 poles phase-to-phase and phase-to-ground. Compare against manufacturer minimum		
7	C10 breaker contact resistance test	Micro-ohm test across C10 main contacts. Compare against manufacturer baseline		
8	C10 breaker trip/close timing test	Verify C10 trip and close times within manufacturer spec using breaker analyzer		
9	Phase rotation verification (SSE1 S2 / CPS C10)	Verify A-B-C phase rotation at both ends of new MV cable using phase rotation meter. Compare rotation at SSE1 S2 termination against existing SSE1 bus rotation. Compare rotation at CPS C10 termination against existing CPS bus rotation. Confirm phase sequence matches before any energization.	Berg (Ryan Corson)	
EXISTING CPS CONTROL SYSTEM VERIFICATION				
10	CPS PLC operational status check	Verify PLC (Rack 3, Rack 4) running, no faulted modules, battery OK. Review existing fault log		
11	PLC I/O scan for feeder #5 slots	Verify Rack 4 Slots 3/4 (new C10 I/O) recognized by processor. No conflicts with existing programming		
12	Existing diesel gen controls verification	Confirm EG5-EG7 start commands, run feedback, breaker status (C12-C14) functional in existing PLC		

#	Verification Item	Description / What to Verify	Responsible Party	Notes
13	Existing gas gen controls verification	Confirm EG1-EG4 start commands, run feedback, breaker status (C1-C4) functional in existing PLC		
14	Existing load shed logic review	Review 3-block priority load shed programming with Strata. Verify blocks correctly assigned and logic functional		
15	Existing tie breaker C5/C11 verification	Verify C5 and C11 open/close commands and position feedback functional in existing PLC		
16	HMI existing functionality baseline	Document current HMI screens, breaker status, alarm functions before modifications. Screenshot baseline		
17	125VDC control power verification	Verify 125VDC distribution panel and both supply alarms (A228, A229) functional. Adequate capacity for new C10 circuits		
INTEGRATOR BENCH / SITE TESTS (Verified by documentation or witness)				
18	Fiber optic link test (CHP-1A to CPS)	Continuity and optical loss on all 6 strands between CHP1A-PP2 and CPS-PP. Record dB loss		
19	SEL-2812 transceiver communication	SEL-2812 MTXO at CPS communicates with 751C10 port 2 via fiber patch cable		
20	RS-485 / Modbus network integration	751C10 communicates on CPS Modbus network. Data points visible at HMI		
21	Mirrored bits link test (bench)	SEL mirrored bits link between SSE1 and CPS relays. Bit transfer confirmed both directions before live breakers		
22	SSE1 Modbus monitoring verification	SSE1 metering and status data transmitting correctly to CPS HMI after modifications		

#	Test Activity	Description	Est. Duration	Personnel Required	Outage Req'd?	Outage Window	FDS Seq Ref	Dwg / Doc Ref	Acceptance Criteria	Potential Failure Mode	Notes
PHASE A: PERMISSIVE INTERLOCK VERIFICATION (No outage - breakers racked out or test blocks)											
1	S2 close permissive: C10 must be open	Simulate C10 closed status via mirrored bits. Attempt S2 close. Then change C10 to open and reattempt	30 min	Strata, Dyna, GMC Cx	No	Normal hours	FDS §6.1a	IP-3201A-1	S2 close blocked when C10 shows closed. S2 close permitted when C10 shows open	Mirrored bits not transmitting C10 status. Relay logic incorrectly programmed. Wiring error on S2 close permissive circuit	
2	C10 close permissive: dead bus + C11 open + C5 open	Simulate bus voltage present on CPS. Attempt C10 close. Remove voltage and verify all three conditions required	1 hr	Strata, Dyna, GMC Cx	No	Normal hours	FDS §6.2a	IP-3201A-1	C10 close blocked when any condition not met. Permitted only with dead bus AND C11 open AND C5 open	Dead bus detection relay miscalibrated. PLC logic error on AND conditions. Aux contact wiring error on C11 or C5	
3	C11 close permissive: C12/C13/C14 open OR C10 open	Simulate diesel breakers C12-C14 closed and C10 closed. Attempt C11 close. Then open C10 or C12-C14 and reattempt	45 min	Strata, Dyna, GMC Cx	No	Normal hours	FDS §6.2b	PLC Logic	C11 close blocked when C12-C14 all closed AND C10 closed. Permitted when C12-C14 open OR C10 open	PLC OR logic error. Aux contact failure on C12/C13/C14. Incorrect breaker status mapping in PLC	
4	C5 close permissive: C10 must be open	Simulate C10 closed status. Attempt C5 close. Change C10 to open and reattempt	30 min	Strata, Dyna, GMC Cx	No	Normal hours	FDS §6.2c	PLC Logic	C5 close blocked when C10 shows closed. C5 close permitted when C10 shows open	PLC logic error. C10 aux contact wiring error. Status feedback delay	
5	S2 trip cascades C10 trip	With both breakers in test position, initiate S2 trip signal. Monitor C10 for resulting trip via mirrored bits	30 min	Strata, Dyna, GMC Cx	No	Normal hours	FDS §6.1a	IP-3201A-1 Note 3	C10 trips within acceptable time after S2 trip initiated. Mirrored bit transfer confirmed	Mirrored bits latency too high. Fiber link failure. 751C10 not programmed to trip on S2 status change	
PHASE B: ENERGIZATION & NORMAL OPERATION VERIFICATION											
6	Initial energization of SSE1-CPS feeder	Close S2 at SSE1 with C10 open. Record voltage at CPS C10 bus side on all three phases. Check for alarms	1 hr	Strata, Dyna, Berg, Penta, GMC Cx	No	Normal hours	-	E-301	Voltage present at CPS C10 bus within 5% of nominal on all phases. No protection relay trips or alarms	MV cable fault. Phase reversal. Cable termination failure. Relay nuisance trip	No CPS outage. C10 stays open. CPS loads remain on gas gens
7	C10 first close under load	Close C10 to transfer CPS load from gas gens to SCE. Monitor voltage, current, power factor at CPS	1 hr	Strata, Dyna, Berg, Penta, GMC Cx	**Yes**	**Night 1**	FDS §4	IP-3201A-1	CPS load transfers to SCE. Voltage stable. No protection trips. Current and power factor within expected range	Dead bus permissive logic fails. Voltage transient trips relay. C10 mechanism failure. Phase mismatch	OUTAGE: CPS load transfers from gas gens to SCE. Brief outage during open-transition switchover
8	HMI status verification	Check HMI screens for breaker status (S2, C10, C5, C11), metering values, 'Utility is available' notification	30 min	Strata, Dyna, GMC Cx, Owner	No	Same window	FDS §5 B1.a	HMI	All breaker positions display correctly. Metering matches field readings. 'Utility is available' message displayed	Modbus communication failure to HMI. Incorrect register mapping. Display coding error	No additional outage. Performed while CPS energized from step above
9	Non-export observation (live)	Observe 751C10 metering with CPS on SCE via C10. Check for reverse power indication and relay element status	30 min	Strata, GMC Cx	No	Same window	-	IP-3201A-1	No reverse power flow detected. 751C10 reverse power element armed and monitoring	Incorrect CT polarity. Relay element not enabled. Metering register configured wrong	No additional outage. Performed while CPS energized from step above
PHASE C: SEQUENCE TESTING - NORMAL OPERATION MODE (Requires CPS outage)											
10	Seq S1: SCE outage, CPS in normal mode	Simulate SCE outage. Monitor response at SSE1 (S1 open, EG8 start) and CPS (C10 open, EG5-EG7 start, load shed)	1.5-2 hrs	Strata, Dyna, Penta, GMC Cx, Owner	**Yes**	**Night 1**	FDS §5.1	ELEN Test 2A	C10 opens automatically. EG5-EG7 start within 10-30 sec. Load shed executes per 3-block priority. CPS loads restored on diesel	C10 fails to open. Diesel generators fail to start. Load shed logic error. EG8 at SSE1 fails to start	OUTAGE: 10-30 sec outage while diesels start. Record load shed blocks and transfer time
11	Seq B1: Return to utility, normal mode short outage	Restore SCE. Operator initiates return. Monitor EG8 synch, S1 close, C10 reclose, diesel disconnect timing	1.5-2 hrs	Strata, Dyna, Penta, GMC Cx, Owner	**Yes**	**Night 1**	FDS §5.4	ELEN Test 2B	EG8 synchs/S1 closes. S3 opens <1 sec. C11 opens, C10 closes. C12-C14 open <1 sec. C11 recloses	EG8 fails to synchronize. S3 isolation >1 sec. C10 close permissive not met. Diesel disconnect >1 sec	OUTAGE: <1 sec during transfer. Record S3 and C12-C14 isolation timing (<1 sec per FDS)
PHASE D: SEQUENCE TESTING - ISLANDED OPERATION MODE (SSE1 impact only - no CPS outage)											
12	Seq S2: SCE outage, CPS in islanded mode	With gas gens running on CPS (C10/S2 open), simulate SCE outage. Monitor SSE1 response	45 min-1 hr	Strata, Dyna, GMC Cx	**No***	**Normal hours**	FDS §5.2	-	S1 opens, EG8 starts and picks up SSE1 load. CPS gas generators continue uninterrupted	EG8 fails to start. SSE1 load shed failure. Unexpected signal sent to CPS controls	No CPS outage. CPS loads remain on gas gens throughout

#	Test Activity	Description	Est. Duration	Personnel Required	Outage Req'd?	Outage Window	FDS Seq Ref	Dwg / Doc Ref	Acceptance Criteria	Potential Failure Mode	Notes
13	Seq B2: Return to utility, islanded mode short outage	Restore SCE. Monitor EG8 synch, S1 close at SSE1. Verify CPS remains on gas gens	30-45 min	Strata, Dyna, GMC Cx	No*	Normal hours	FDS §5.5	-	EG8 synchs, S1 closes, S3 opens <1 sec. CPS gas generators continue uninterrupted	EG8 fails to synchronize. Unexpected C10 close attempt. False 'utility available' signal to CPS	No CPS outage. Only SSE1 transitions back to utility. Record S3 isolation timing
PHASE E: GAS GENERATOR FAILURE SCENARIOS (Requires CPS outage)											
14	Test 1A: Gas gen failure, SCE available	Open C1-C4 to simulate gas gen failure with SCE available. Monitor auto-transfer to SCE via C10	45 min-1 hr	Strata, Dyna, GMC Cx, Owner	Yes	Night 2	FDS §4	ELEN Test 1A	Controls open C5, close C10 transferring CPS to SCE. Outage <1 sec. Voltage stable after transfer	C5 fails to open. C10 close permissive not met. Auto-transfer logic not triggered	OUTAGE: Brief outage during switchover. Record transfer time (<1 sec expected)
15	Test 1B: Gas gen failure, SCE not available	Open C1-C4 and S2 to simulate gas gen failure without SCE. Monitor diesel start and load shed	1-1.5 hrs	Strata, Dyna, GMC Cx, Owner	Yes	Night 2	FDS §3.3 / §5.1	ELEN Test 1B	Controls open C5. EG5-EG7 start, C11 closes within 10-30 sec. Load shed per 3-block priority	Diesel generators fail to start. Load shed does not execute. C11 close permissive not met	OUTAGE: 10-30 sec. Record load shed blocks and pickup sequence
16	Test 1C: Restore gas gens from diesel backup	Manual operation by plant operator. Close C5, start gas gens, synchronize with diesels, open C11, disconnect diesels	1-1.5 hrs	Strata, Dyna, GMC Cx, Owner (operator)	Yes	Night 2	FDS §5.3 (Seq L)	ELEN Test 1C	Gas gens start, synchronize without trip. C5 closes, C11 opens, diesels disconnect. No outage	Gas gen fails to synchronize. Synch check relay blocks close. Operator error during manual sync	OUTAGE RISK: Manual sync risk. Plant operator required
PHASE F: EXTENDED OUTAGE / PSPS SEQUENCE (Requires CPS outage)											
17	Seq L: Extended outage - start gas gens on diesel	With campus on diesel (run Seq S1 first as prerequisite), operator manually initiates gas gen start and synch with diesels	1.5-2 hrs	Strata, Dyna, GMC Cx, Owner (operator)	Yes	Night 3	FDS §5.3	-	EG1-EG4 start and synchronize with EG5-EG7. Gas gens pick up load. Paralleled operation stable	Gas gen start failure. Synchronization failure. Overcurrent during parallel. Load imbalance	OUTAGE: Seq S1 prerequisite (10-30 sec). Manual gas gen sync risk. Record gen isolation timing
18	Seq B3: Return to utility from extended outage	Restore SCE. Full return: EG8 synch/S1 close, diesel and gas gen disconnect, C10 close, system return to normal	1.5-2 hrs	Strata, Dyna, Penta, GMC Cx, Owner	Yes	Night 3	FDS §5.6	-	EG8 synchs/S1 closes. S3 opens <1 sec. C11/C5 open, C10 closes. All gen breakers open <1 sec. C11 recloses	EG8 sync failure. Generator isolation >1 sec. C10 close permissive not met. Sequence stalls	OUTAGE: Multiple transfers. Record all isolation timings (<1 sec per FDS). Most complex sequence

LEGEND

Red rows	Requires CPS load outage. Outage night per owner approval.
Amber rows (No*)	SSE1 side impact only. CPS loads unaffected (remain on gas gens). Normal hours.
White/blue rows	No outage required. Normal working hours.