Integrated Automation - Controls Design Standard and Control Points List Spreadsheet for CEMCS

Division 250000-8

Introduction to CEMCS Requirements with instructions for the A/E in the use of the CEMCS Control Points List Spreadsheet.

This document is to assist the architect/engineer (A/E) in designing and specifying project components to comply with the Commonwealth Energy Management & Control System (CEMCS).

What is CEMCS?

CEMCS is a state-wide enterprise program being implemented by the Commonwealth of Kentucky Division of Facility Efficiency to (1) track state-wide energy usage as mandated by state law, and (2) actively reduce the energy consumption of state facilities by the use of sophisticated data analysis tools.

To those goals, the CEMCS program has the following stages:

Tier 0 - Energy usage tabulation

Tier 0 energy tabulation may be as simple as manual entry of energy consumption data in to a CEMCS database from a paper utility bill. This data entry facilitates the most basic CEMCS function of tracking energy usage. Electronic Data Interchange (EDI) may be enabled.

Tier 1 - Electronic billing and automated payment of utility bills, where feasible.

The CEMCS team is working with state utility company to explore the feasibility of electronic billing and automated bill auditing and payment. At this time, we have a few of the larger utility companies who are successfully using the system to bill and receive payments. Bills are also examined for proper taxation, rate structure, meter identification and automated auditing of unusual billing amounts. As with Tier 0 data, Tier 1 data is added to the master energy usage database. Tier 1 is mandatory with implementation of Tiers 2 and 3.

Tier 2 - Interval electrical meter data analysis

Lacking any other building trend data (e.g. Tier 3 data), much can be learned about how a building operates simply by looking at available interval data from the building electric meter, along with monthly bills for gas and other heating fuels. So-called "smart meters" are the preferred way to obtain interval data. In some cases, smart meters may be installed as part of a capital project, or in some cases, the meter data may be obtained from the electric utility company.

Tier 3 - Building Automation System trend data analysis

In this process, point trend data from the Building Automation System (BAS), otherwise known as the HVAC digital control system, is exported from the BAS on a daily basis to a remote server, and then added to a master database within the CEMCS server domain. CEMCS has sophisticated tools to analyze the building trend data and help identify areas where operating efficiencies may be enhanced.

To simplify the future integration of a project BAS into CEMCS, a degree of standardization of the buildings controls systems must occur. This standardization does not dictate the brand of control systems being used; rather the requirements for (a) communicating with the CEMCS database as to format and rate, (b) the control systems architecture required to meet the CEMCS objectives and (c) control point data required to adequately diagnosis the performance of the building's controlled systems.

Requirements for items (a); the communication format and (b); the control system architecture, are presented within the Spreadsheet Tab: "CEMCS System Requirements" of this spreadsheet. These requirements should be familiar to those, within the A/E community, accustomed to specifying controls systems.

The requirements of item (c), the CEMCS control points data collection, are considerably more complicated.
1. They require the control system to collect the information needed to diagnosis the performance of the building.
2. The control system must trend this data in increments and for durations that are valuable for this diagnosis.
3. The point information must be in a consistent format such that the CEMCS program and staff can readily identify the location and nature of the point data being collected.
4. And finally, there must be some uniformity as to what points are required for the various building systems being controlled.

Note: The control system design A/E for DECA projects typically will not be involved with the mechanics of actually implementing the data transfer process (e.g. getting the data out of the BAS and transmitting the data to CEMCS). Those functions will be accomplished in a separate effort led by the Division of Facility Efficiency which operates CEMCS. Thus, spreadsheet Item #4 (Tab 1), which references to data transfer (e.g. ftp sites, servers, scripts, etc.), will not be a part of this effort. Rather, the efforts will be confined to making sure the new BAS conforms to the minimum standards that will most easily facilitate such data transfer.

Applicability to DECA Projects

In the absence of specific BAS requirements from the Using Agency (e.g. KCTCS), the following system architecture requirements will apply:

Communication Format and Control System Architecture

In order to facilitate the requirements of CEMCS and this DECA Design Standard, the controls system Designer must incorporate the requirements listed under the spreadsheet tab "CEMCS System Requirements". This architecture and communications format must be incorporated into the project control system specifications. If the application is such that a Building Automation System is not practical, these requirements may only be waived with written approval of the DECA Project Manager. In such case, the building must, at a minimum, be equipped with Smart Metering capability which can interface and report to the CEMCS server. Without this minimum provision, both the Using Agency and the DECA Project Manager must provide written authorization to report the buildings energy consumption by alternative methods in accordance with the requirements of House Bill 2, enacted in 2009.

Control Points List Spreadsheet

The following is a description of how to utilize this CEMCS Control Points List Spreadsheet. This spreadsheet has not been developed as a design tool, although a knowledgeable designer could utilize it as such with some effort and ingenuity. Rather this Design Standard was developed for the purpose of communicating the intent of DECA regarding control system uniformity. As such, its capabilities are limited to this objective and will be an evolving document as new systems become popular or obsolete.

System Selection

This Control Points List Spreadsheet is subdivided into spreadsheets tabs grouped by system type. These system types are currently classified into the following spreadsheet tabs:

System Selection Subcategories

- Room Units   (PTAC, Mini-Splits, Fan Coils, Unit Ventilators, WSHP, etc.)
- CW – VAV AHU   (Chilled Water, VAV, AHU's)
- Metering and Monitoring
- Exhaust Fans
- 100% OA Units   (Makeup Air Units)
- Air Terminal Units
- CW SZ AHU   (Chilled Water, Single Zone, AHU's)
- CW DD AHU   (Chilled Water, Double Duct, AHU's)
- DX RFT & SS SZ AH (DX Rooftop & Split System, Single Zone Air Conditioning Equipment)
- DX RFT & SS VAV AH (DX Rooftop & Split System, VAV Air Conditioning Equipment)
- Energy Rec Vent Units (Energy Recovery Ventilating Units)
- Lighting Systems

- Unitary Heat   (Radiation, Unit Heaters, Cabinet Heaters, Reheat, etc.)
- Equipment Monitoring Interface
- WSHP Loop Systems (Water Source Heat Pump Loop Systems; Pumps, Boilers, Towers, etc.)
- Chilled Water Systems   (Pumps, Chillers, Towers, etc.)
- Hot Water Systems   (Pumps, Boilers, etc.)

Within each of the subcategory tabs is a listing of the most common equipment / sub-component configurations encountered in the Commonwealth's facilities for that subcategory. This listing should be considered as extensive but by no means exhaustive in nature. There will be combinations that cannot realistically be incorporated into this document.

These configurations are presented in Column A of each spreadsheet tab. In most cases this list is too lengthy to be effectively searched; therefore each spreadsheet includes an Excel filter provision to simplify the selection process. This filter is also located in Column A within the first 10 rows (typically row 6) and is labeled "Filter List Here". The Designer need only right click on the dropdown arrow to reveal the system sub-components within the current spreadsheet.

 For instance under the "Metering and Monitoring" tab the filter drop down allows you to choose among sub-components such as:
- Analog BTU meter
- Analog Chilled Water Energy
- Pulse Chilled Water Energy
- Analog Electric Meter
- Pulse Electric Meter
- Analog Fuel Oil Meter
- Pulse Fuel Oil Meter
- Analog Gas Meter
- Pulse Gas Meter
- Outside Air Conditions / History
- Outside Air Conditions / Degree Day

Upon selecting the appropriate sub-component the spreadsheet filters the points list to only those applicable to the sub-component selected in the filtering provision. (As a practical matter, if the project requires the designer to utilize multiple systems within this spreadsheet, it is more expedient to copy and paste each configuration into another spreadsheet organized specifically for that project.)

Additional Point Information

Agency Point Priority

Column B of each system subcategory contains another filtering provision headed as "Agency Point Priority". The purpose of this Agency Point Priority column is to communicate what priority to apply to various points which might be included in the Designer's point list specification.

CEMCS requires certain points to be trended; yet there are numerous points which although not required for energy diagnostics, do represent information the Using Agency would like to monitor through CEMCS.

The Designer should also note that the points listed may include points not applicable to the equipment / system being considered. For instance the Gas Heating / Cooling Rooftop points list will include provisions for four stages of heating control which may well be beyond the number of stages available on most packaged rooftop units. It is not intended for the points list to become prescriptive as to accessories or options that might be applied to the referenced item. The Designer is still responsible for the design of the systems and their controls elements.

However certain information is required to achieve the CEMCS goals and the preferences of the Using Agency. Therefore the points list spreadsheet includes the "Agency Point Priority" filter provision. Each point has a priority code attached, ranging from 1 to 4. This priority code is to be interpreted as follows:
1. Required
2. Required where applicable
3. Recommended
4. Recommended where applicable

Therefore the Designer is expected to include within the controls specification the points prioritized as #1 and if in fact the point is applicable those prioritized as #2. The Designer is expected to work with the Using Agency to determine the Agency's preference as to those points prioritized as #3 and where applicable those prioritized as #4.

So if the Designer wishes to view only the points required by CEMCS, the filter would be configured to only the #1 grouping. The more recent spreadsheet program versions include provisions to include or exclude various combinations of the filter selections.

With these steps complete the Designer has a base points list by which the control points list specification may be more fully defined as appropriate to the Owner's Project Requirements.

I /O Point Abbreviation

The next step for the Designer is to apply abbreviations the Controls Programmer can utilize to develop unique point identifiers, such that CEMCS can trend each point in the project. These point abbreviations are to be consistent and recognizable to the CEMCS and Agency staff. Therefore the recommended point abbreviations are included in the

spreadsheet. The Designer is strongly encouraged to utilize these abbreviations presented to describe the project points. The abbreviations have for the most part been extracted from ISA (Instrument Society of America) and the National CAD Standard abbreviations. It is important to DECA, the Using Agencies and to the CEMCS effort for this nomenclature to be used not only in the points list but also within the Sequence of Operations descriptions and within the equipment / device schedules. Guidance for undesignated points may be found within ANSI/SA S5.1-1984 (R 1002) standard or on websites such as www.engineeringtoolbox.com referencing ISA Codes for Process Instrumentation.

Previously the tagging of equipment and control points has been left to the discretion of the Designer. However in support of the CEMCS requirements the Designer will be expected to adopt nomenclature consistent with that presented within this design standard document. The Designer is directed to the CEMCS Spreadsheet subcategory tab "Equipment Tagging Nomenclature" for the MEP equipment nomenclature guidelines presented by this Standard. Deviation from this naming convention on DECA projects requires approval by the Project Manager.

For instance a high static pressure switch in the supply air duct is designated as "SA_HSP_S". This communicates the point is located in the "SA" supply air, it is sensing "HSP" high static pressure and is a "S" switch which identifies it as a binary device thus the CEMCS or Agency staff knows to look for a Normal/Fail, or 1/0 value being reported by the BAS. The supply air static pressure sensor on the other hand is designated as "SA_SP", again "SA" indicating supply air and "SP" sensing static pressure but without the switch designation the staff will now look for an analog value to be reported to the CEMCS database.

When this document does not suggest an abbreviation or nomenclature applicable to a point or device required for the project, the Designer is expected to look to the National CAD Standard or the ISA for guidance. The format of such an item should still be consistent with the format presented within this standard.

P&ID Tag Identification

It is intended that the project's controls point list be included with the Sequence of Operations and P&ID's ("Process & Instrumentation Diagrams" or flow schematics and instrumentation diagrams) in the project drawing package. The P&ID Tag column in the Controls Points List Spreadsheet is intended to be incorporated into the project's controls point list. Its purpose is to cross reference the P&ID instrument tag with the control point identification.

For instance the supply air temperature for a given air handler will have a point abbreviation of SA_T and a unique point identifier developed by the controls programmer; however if it fails, the technician wanting to change it will need to know that it is the temperature transmitter designated as TT-503 on the P&ID and within the materials list, so that he will be able to order a replacement and locate it in the system.

For this reason where a point is directly related to a device it is intended that the designer include that cross-reference designation in the control points list P&ID Tag column.

Point Location Identifiers

There are a number of additional identifiers the Designer must provide the controls programmer so that the unique point identifiers will indeed be unique. They are as follows:

KY Archibus Building ID #: Each building operated by the Commonwealth of Kentucky is assigned an asset ID # and is tracked within the Commonwealth's Archibus database. The Designer is to include this ID # within the project's Controls Point List. This ID# can be acquired from the DECA Project Manager.

Building Area Served Identifier: It is recommended that the Designer provide the controls Programmer with a Building Area Served identifier that reflects an appropriate sub-division of a larger building. This identifier is at the Designer's discretion but should be consistent with the projects drawing presentation. For instance if the building consist of multiple floors and multiple wings, the Designer might include a designator for the East wing of the Second Floor as "2E". The intent is to assist the Using Agency in responding to specific non-performing points in a more efficient manner. However, correlating a point to a more specific location, such as a room number, is discouraged; as these more specific designations tend to change with time.

Discipline and Drawing Layer Identifiers

It is intended that the Discipline and Drawing Layer Identifiers nomenclature be adopted from the National CAD Standard or the standard designated as the drawing standard adopted for the subject project. Deviation from the National CAD Standard requires approval from the Project Manager.

Discipline Identifier: This discipline identifier should be consistent to the project drawing discipline nomenclature, such that the location of the point may be correlated to the unique point name. For instance if all electrical drawings are referenced with an E prefix, and the corresponding points list applies to an electrical device such as a power monitor, then this identifier should be "E". If on the other hand the electrical drawings are divided into sub-disciplines; for instance power is under an EP discipline designator, then "EP" would be the appropriate Discipline identifier for the power monitoring points list.

Drawing Layer Identifier: The National CAD Standard puts forth certain recommendations for managing drawing layers within the project drawings. It is DECA's recommendation that the control points name be associated with the drawing layer that presents the devices associated with the points. The National CAD Standard also

suggests the possibility of Major and Minor Layer groups. For instance a point associated with a piece of HVAC Equipment could be associated with a HVAC major layer and an EQPM minor layer.

These designations are now becoming important in the management of drawings within BIM project delivery methods. Therefore the Designer is encouraged to correlate the point devices or equipment with the Drawing Layer Major or Minor Group within the Controls Points List such that the controls Programmer can incorporate this information into the unique point identifier.

System Component Identifier

The system component identifier is an important element of the unique point name. For CEMCS and the Using Agency to gain full benefit from these point identifiers the system component must be correlated to the point. Typically the System Component is a piece of equipment such as air handling unit "AHU-7" or air terminal unit "VAV-35". This project equipment designation is what is intended for the "System Component Identifier" element.

However, it is incumbent upon the Designer to coordinate the project's equipment designators with the existing equipment tagging. There cannot be two AHU-1's within the same Archibus Building.

I / O Point Unique ID

The I / O Point Unique ID# is strictly the domain of the controls Programmer. These numbers require no input from the Designer as to selection. However the Designer is expected to leave fields within the Controls Point List documentation such that the Programmer will record the Unique ID# assigned to the listed point in the Record Documents. The Designer is likewise responsible to verify this information is captured in those Record Documents.

Summary

The "Controls Points List Spreadsheet is a tool for control systems Designers and Programmers which communicates DECA's intentions for implementing the provisions of CEMCS and providing more uniformity in the control systems product being provided to the Commonwealth's various Agencies.

A brief recap of the steps required for the Designer to use this tool is as follows:

1. Incorporate the Control System Architecture and the CEMCS Communication Format requirements found under tab "CEMCS System Requirements" into the project control system specifications.
2. Identify the project Components and Equipment tagging consistent with the nomenclature presented in the "Equipment Tagging Nomenclature" tab or as referenced in the applicable Drawing Standard.
3. Locate the system sub-category tab in the spreadsheet that applies to the system, component or equipment points list being selected.
4. Within the system sub-category spreadsheet, filter the component / equipment listing in Column A to the points list that best fits your application. If specifying multiple items it is best to copy the current selection to another spreadsheet specific to the project.
5. With your working points list, filter and edit the points list to match the application.
6. If additional points are required for a component, add an appropriate point abbreviation to the "I/O Point Abbreviation" field consistent with the format of this standard's point abbreviations.
7. Where discrete instruments are associated with a point in the project's P&ID or Flow Diagrams, add the instrument's tag identifier into the "P&ID Tag" field. Leave blank if no discrete cross reference applies.
8. Enter the KY Archibus ID# into its field.
9. Enter an Area location reference to the "Building Area Served" field.
10. Enter a Discipline identifier into the "Discipline" field.
11. Enter the drawing layer designations into the National CAD Standard Major Group and Minor Group (if applicable) fields.
12. Enter the system component /equipment tag designation into the "System Component Identification" field.
13. Make provisions in the point list for the controls Programmer to enter the "I/O Point Unique Identifier" into the corresponding field.
14. Verify that all the information is appropriately incorporated into the Record Drawings / Documents.