Pacific Northwest
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PNNL-39862

Contingency Base Energy Management System (CB-EMS)

Administrators Manual

September 2026

JC Tucker
JK Goddard

U.S. DEPARTMENT of ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Abstract

Contingency bases, also known as expeditionary bases and forward operating bases, are used by the Army at temporary sites to allow military forces to perform expeditionary warfare, humanitarian efforts, and disaster relief. Because of their remote locations, contingency bases are often powered by generators, which require a considerable amount of fuel. The high cost of delivering fuel to these sites, along with the risk to personnel delivering that fuel, makes energy efficiency a high priority.

The Contingency Base Energy Management System (CB-EMS) is a software application that enables the camp manager to monitor camp energy operations and identify issues that can cause excessive energy consumption. It also gives the camp manager real-time visibility of the fluid levels for all camp fuel and water tanks, as well as the consumption to estimate how long the current reserves will last. Instrumentation throughout the camp provides information to the system. These include the structure temperature, energy usage, and generic metering to monitor other parameters. Generators are monitored for performance to maintain system efficiency. Solar photovoltaic arrays are monitored by CB-EMS to allow efficient operation of those resources.

CB-EMS is built using Ignition by Inductive Automation as the Supervisory Control and Data Acquisition (SCADA) platform. Ignition runs using Java within their Vision Client Launcher. CB-EMS uses instrumentation throughout the camp to create an energy “dashboard” to enable the camp manager to view the camp and identify areas where the camp is outside operational guidelines.

This user manual is developed to enable the camp administrator to perform the initial configuration of the system and maintain the system as the base changes. The main dashboard must be customized and manually configured for each site, and instrumentation must be set up and connected to the software. A separate manual for CB-EMS users details how the camp dashboard is used during operations, and a third manual is provided to document how to set up a new system head end.

Acronyms and Abbreviations

AMMPS	Advanced Medium Mobile Power Sources
BCIL	Base Camp Integration Laboratory
CB-EMS	Contingency Base Energy Management System
CBITEC	Contingency Base Integration Technology Evaluation Center
DMMS	Deployable Metering and Monitoring System
ECU	electronic control unit
SCADA	Supervisory Control and Data Acquisition

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1.0 Introduction

The Contingency Base Energy Management System (CB-EMS) is a government-owned expert system designed to integrate site operations and energy management at contingency bases. Contingency bases, or base camps, are nonenduring locations outside the United States that support and sustain operations during contingencies or other operations and are categorized by mission life-cycle requirements as initial, temporary, or semipermanent. CB-EMS is a tool that enables base camp managers to operate and manage their camps in the most effective and efficient manner.

CB-EMS provides detailed information on camp operations that allows the camp manager to identify issues related to important functions such as power, fuel consumption, water consumption, and equipment maintenance. The main “dashboard” screen provides a quick visual representation of the camp and highlights areas that are outside operational parameters. Once an issue is identified, CB-EMS provides the camp manager with detailed information that enables them to identify the problem and act accordingly. CB-EMS also monitors fuel and water supplies, offers the camp manager an indication of how much of these resources the camp is consuming, and predicts the amount of time left before the available fuel and water are consumed.

When deployed, CB-EMS provides detailed information for the camp manager to run the base efficiently. In addition to reducing energy use at the camp, thus reducing energy consumption, it also provides the following benefits:

- Fuel and water consumption information improves camp readiness.
- Efficient operation of generators extends equipment life.
- Maintenance staff workload is reduced.
- Maintenance parts and labor costs are reduced.

CB-EMS is designed to be user configurable so that the CB-EMS administrator can add new resources during operations and remove them as the camp changes. This plug-and-play capability allows the software to be customized on the fly as the camp changes.

The remainder of this report consists of the following sections:

- Section 2.0, Dashboard Development, describes how to set up the camp screen.
- Section 3.0, Logging in to CB-EMS, provides instructions for starting CB-EMS.
- Section 4.0, CB-EMS Configuration, gives details on configuring equipment for CB-EMS.

2.0 Dashboard Development

Note: It is assumed that all users are familiar with standard Microsoft Windows functions, such as opening, closing, and resizing windows and using the mouse.

The dashboard page is developed within Ignition, an integrated software platform for Supervisory Control and Data Acquisition (SCADA) systems, and provides the basis for the camp layout. The user can place icons indicating the structure, generator, and storage tanks on a camp layout to provide the locations for those items. The default dashboard for CB-EMS is based on the layout of the Contingency Base Integration Technology Evaluation Center (CBITEC) at Ft. Leonard Wood. To customize the dashboard, the administrator must use the Ignition software. The developer of Ignition software, Inductive Automation, offers training that would enable an advanced administrator to further customize the base dashboard to better represent the physical layout of the camp.

2.1 Logging in to Ignition Designer

Ignition Designer is based on Java and will run using the launcher provided by Inductive Automation. A shortcut, similar to Figure 1, is provided on the CB-EMS desktop to start Ignition Designer.

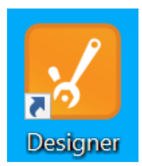

Figure 1. Ignition Designer shortcut.

Double-click the *Ignition Designer* shortcut to start the login process. The shortcut will open a screen similar to Figure 2. Ignition Designer will request the administrator’s username and password (Figure 2). Enter the username and password provided by your system administrator and click *Login*.

Figure 2. Ignition Designer login.

The Open/Create Project window will display. Click the OPEN button in the CBEMS_Site row. This will open the Ignition Designer screen and allow editing of the site map.

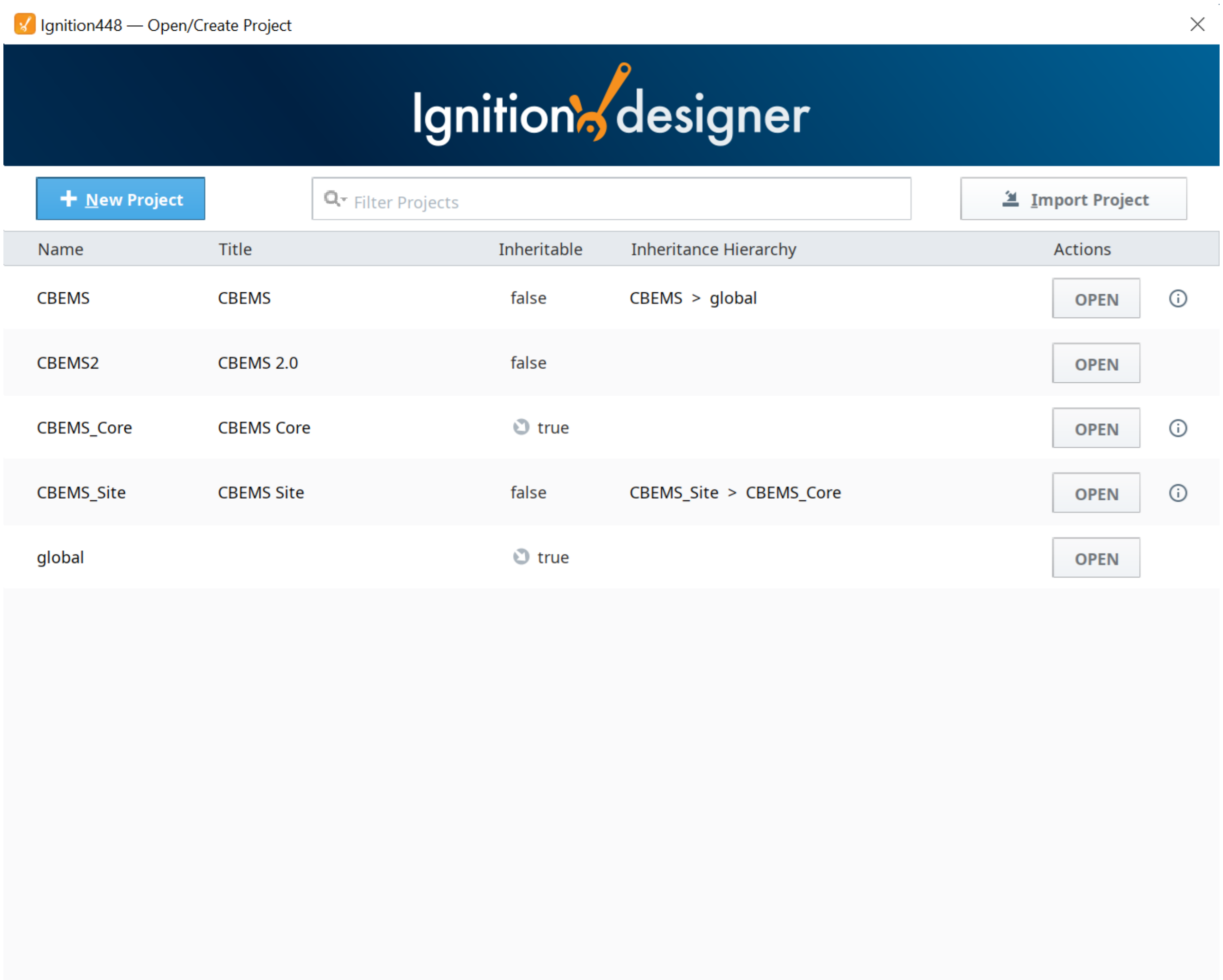

Figure 3. Open/Create Project window.

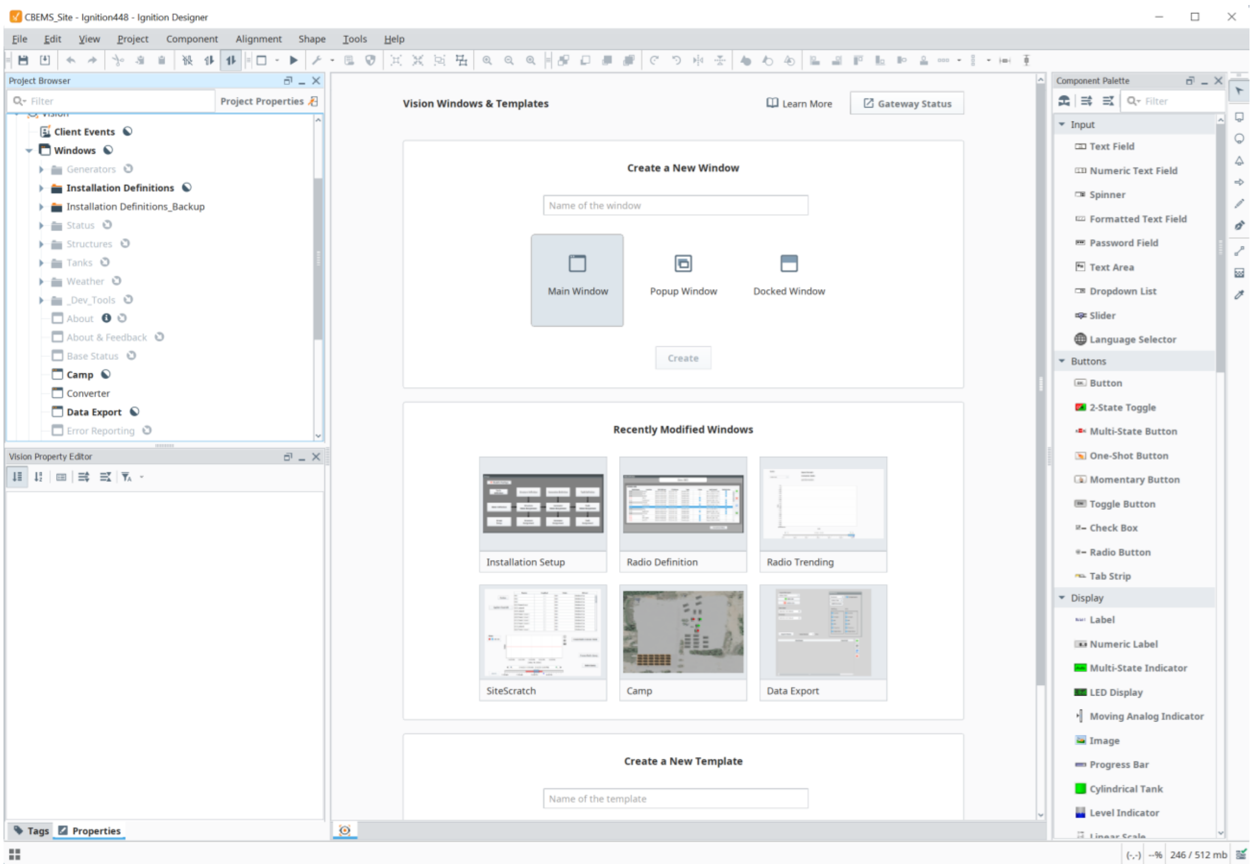

Figure 4. Ignition Designer.

2.2 Creating the New Dashboard

Once the CBEMS_Site project is loaded in Ignition Designer, you will have access to modify the camp map. In the file tree shown on the left side of Figure 4, expand the folders *Vision > Windows* by clicking the triangle next to the filename or double-clicking the filename. Double-click *Camp* to open the window. This is where you will create your physical map of the camp.

The site map in Figure 5 is representative of CBITEC at Ft. Leonard Wood. Each site is likely to be unique, and it is beneficial to have a site map that accurately represents the camp layout. CB-EMS contains many windows that provide information to the user. Only one window, labeled Camp, should be modified to provide a new dashboard. All other windows are designed to function using the menu system and are not site specific.

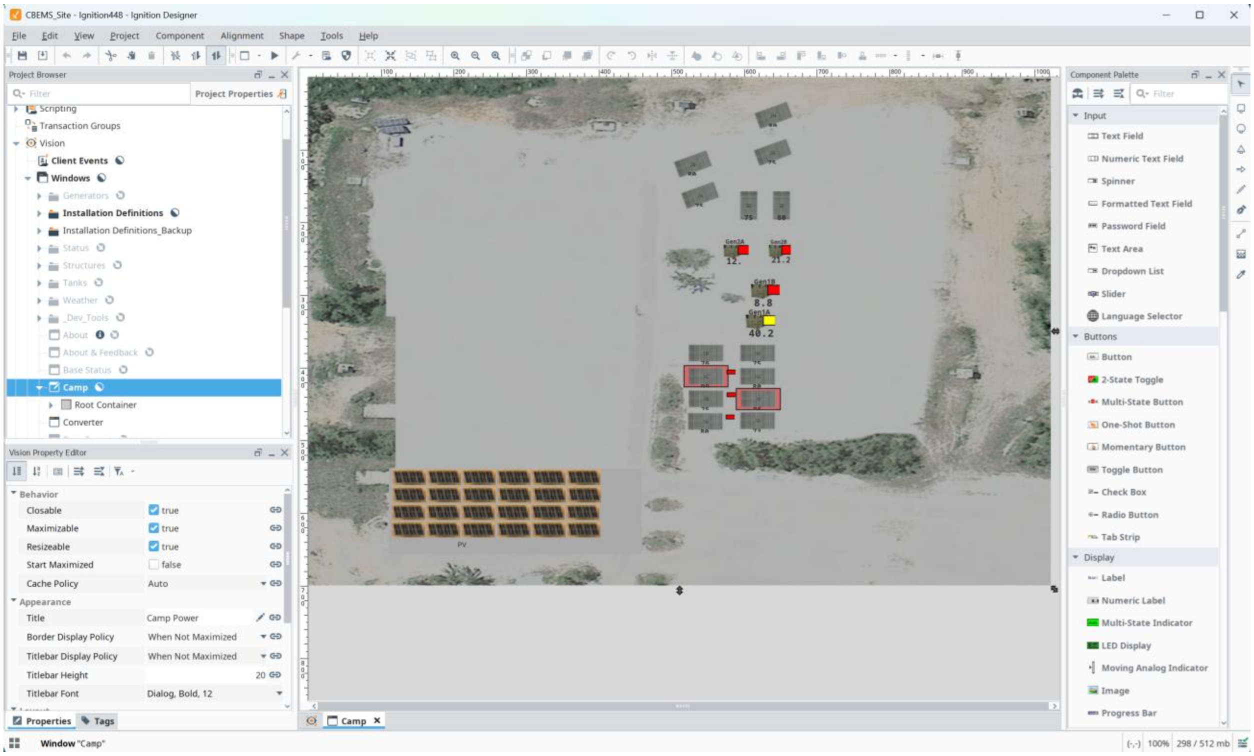

Figure 5. Camp map.

2.2.1 Uploading the Camp Image

First, add an image of the site to the Ignition images database. Ignition can use .gif, .jpg, or .png images. If you don't have an image to use, sometimes it is convenient to use satellite imagery from mapping sites. To add your image to Ignition, select *Tools > Image Management* from the Ignition toolbar to open the Image Management window (Figure 6).

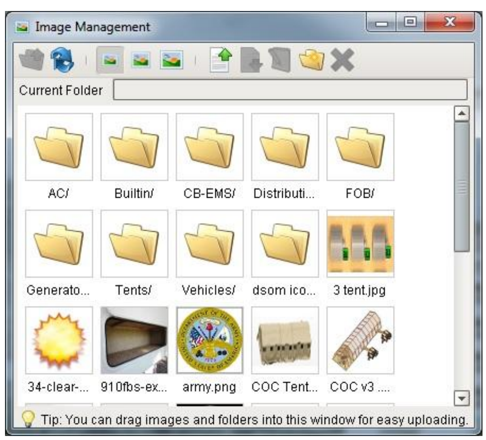

Figure 6. Image Management window.

To insert a new image, click the *Upload* button (up arrow) and use the pop-up file browser to select your image. New site images should be placed in the root folder in the Image Management file system. Other folders contain specific types of images; for example, the Generators folder contains images of generators for use within CB-EMS.

2.2.2 Selecting the New Camp Image

Once the new site image has been uploaded, it is time to insert it into the Camp window. Each page or popup within CB-EMS is referred to as a window in Ignition. The Camp window is the main dashboard window and was opened in Section 2.2. If it is no longer opened, to open the Camp window, in the Project Browser in the upper left part of the screen, double-click *Camp* (Figure 7); it will have a green arrow next to it. The Project Browser is a configurable window and can be moved and closed by the user. It may appear in any location on the screen when Ignition is started or not be visible depending on where the last user placed it. The upper left corner of the window is the default location.

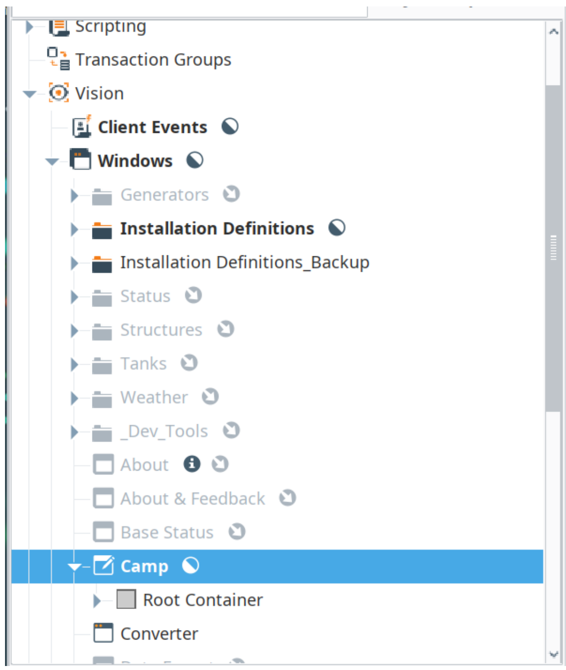

Figure 7. Camp window select.

If the Project Browser is not visible, select *View* > *Panels* in the menu system (Figure 8) and make sure that Project Browser is checked. Also make sure that the Vision Property Editor and Tags Browser are checked.

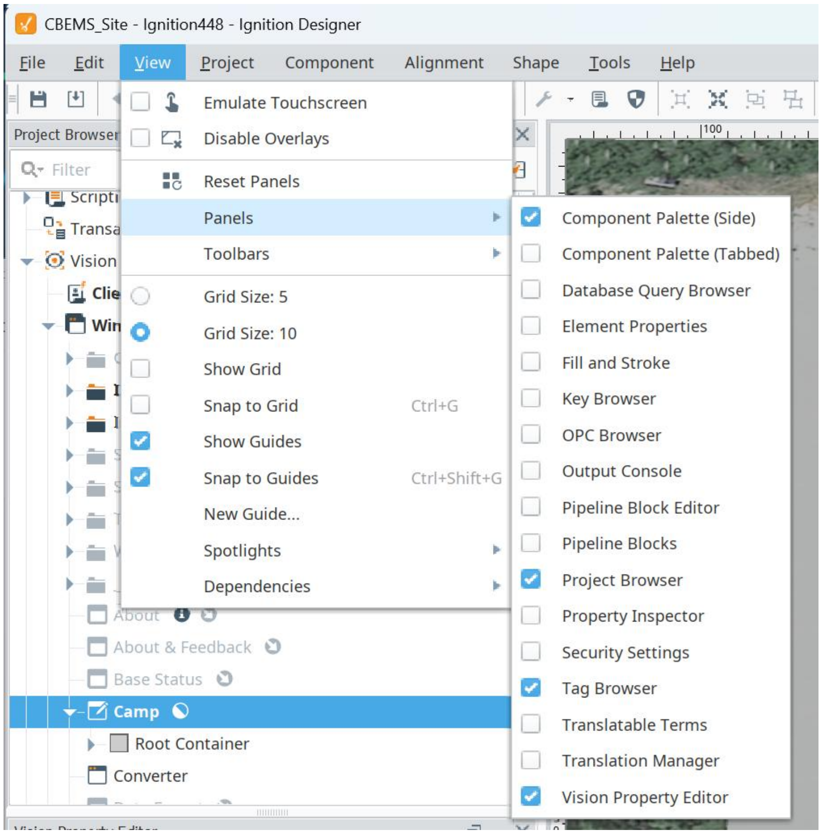

Figure 8. Enable Project Browser.

Expand *Root Container* > *Group* and click Site Image (Figure 9). In the Vision Property Editor (Figure 10), find the Image Path property.

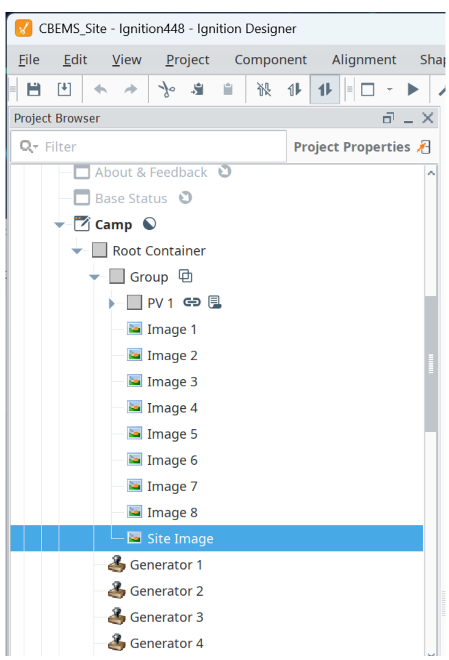

Figure 9. Site Image location.

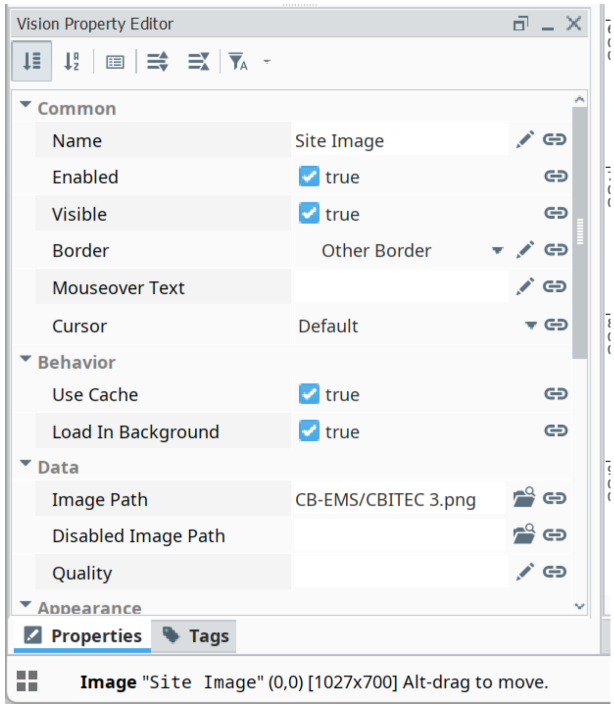

Figure 10. Property Editor.

Click the folder icon next to the Image Path and select the image that you uploaded in Section 2.2.1 from the pop-up window. This will replace the current image with the one you just uploaded. If the Vision Property Editor is not visible, select *View* > *Panels* in the menu system and check *Property Editor* (Figure 8). If the Image Path property is not visible, try the following. Select the Properties tab of the editor (Figure 10). Change the property filter to all by clicking on the down arrow next to the funnel icon in the menu bar of the Vision Property Editor and selecting all from the dropdown menu.

2.2.3 Adding Structures, Generators, and Tanks

Once you have loaded an image of the camp, it is time to add structures to the camp. Templates have been created to allow a user to develop the dashboard more easily. Templates include all the functionality to display current information about each type of system. Templates are located in the Project Browser tab below the windows. You may have to scroll down in the Project Browser to display the templates. All CB-EMS templates are located in the *Templates* > *Equipment* folder. Note that the templates are grayed out because they are members of the core project and not the site project. You can still drag them into place by expanding the menu.

To add a structure, click and drag the template *Structure 1* (highlighted in Figure 11) to its physical location in the Camp window. Resize as necessary to reflect the structure's physical size on the camp map. Repeat as necessary to add more structures. Each structure added to the dashboard is named incrementally as Structure 1, Structure 2, and so on. This is the widget name. When added, no image or data will be shown until an image is associated with it and metering is attached to it. This process will be covered in a later section.

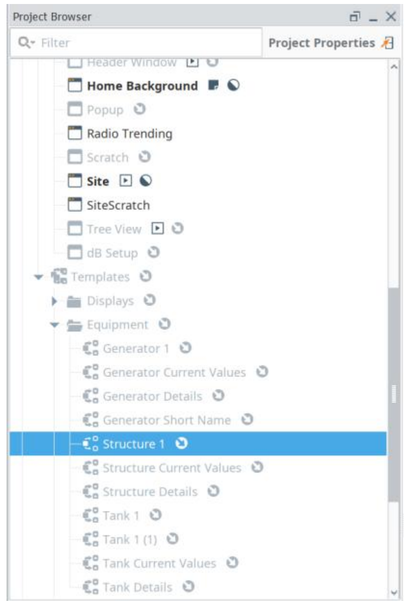

Figure 11. Inserting structures.

Once the structure is added, you must name it to allow meters to be connected to it. This is done in the Vision Property Editor (Figure 12). The name of the structure must be added to the StructureName property. For all items, a name must be given that will match the name of that item that will be assigned later in the Structure Definition page (Section 4.2.2). Additional properties are discussed as follows. The IconAngle property uses the number of degrees from due north and can be used to rotate the structure to match the physical layout. StretchHeight and StretchWidth can be used to adjust the structure image.

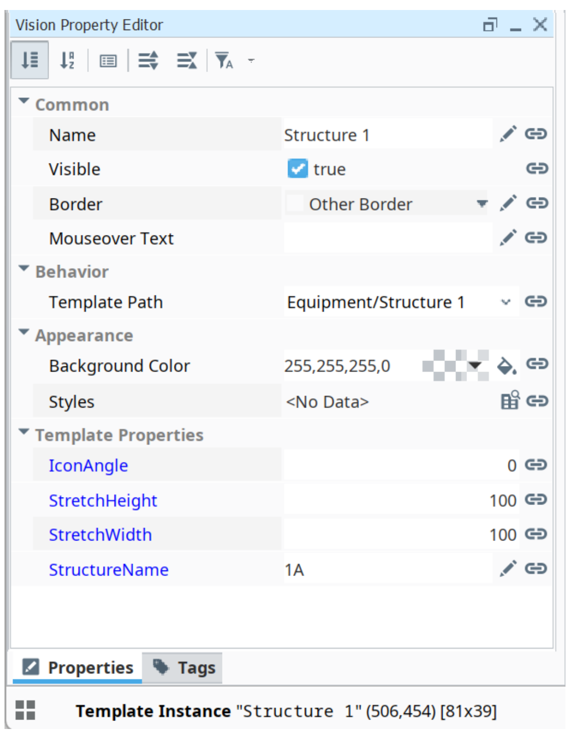

Figure 12. Structure naming.

The process for adding generators and tanks is the same as it is for structures. You should now add generators and tanks as needed. As with structures, each additional generator and tank will be added and named incrementally as Generator 1, Generator 2, etc. and Tank 1, Tank 2, etc. Remember, as with structures, you must provide a name for each generator and tank using the respective GenName and TankName properties in the Vision Property Editor. Unlike structures, generators and tanks do not have IconAngle, StretchHeight, or StretchWidth properties.

Once all equipment has been added to the camp dashboard, it is time to save and close Ignition Designer and open CB-EMS to configure the meters and associate them with the structures, generators, and storage tanks. Close Ignition Designer following standard Windows procedures and proceed to Section 3.0 to configure the system.

3.0 Logging in to CB-EMS

Note: It is assumed that all users are familiar with standard Microsoft Windows functions, such as opening, closing, and resizing windows and using the mouse.

CB-EMS is a Java-based application running from a server location. Any desktop computer with access to the server can have Vision Client Launcher installed to access the system. All software will be installed by the system administrator prior to use.

CB-EMS is accessed via your web browser. The path to access CB-EMS is site specific and will be provided by your system administrator. Once CB-EMS has been loaded on your computer, follow your site's instructions to start the software (Figure 13).

Figure 13. CB-EMS icon.

No username or password is required to open and operate CB-EMS. Certain pages within CB-EMS require an administrator username and password. This includes the Installation Setup page, which is covered in Section 4.2. Once CB-EMS is loaded, the camp screen will show the camp status (Figure 14). For information on operating CB-EMS, refer to the CB-EMS user guide.

Figure 14. Camp.

4.0 CB-EMS Configuration

Once the camp image and templates have been added to the dashboard, the details of the structures, generators, and fuel tanks need to be added to the system, along with the meters that are used to measure the parameters to be monitored. Configuration pages have been developed to guide the administrator through the system setup process.

4.1 Overall Architecture

CB-EMS uses meters and sensors to monitor parameters and provides that information in the dashboard. These meters and sensors are associated with structures, generators, and tanks in the configuration pages. The hardware that delivers the information from these sensors to CB-EMS is provided by the Deployable Metering and Monitoring System (DMMS) program. This includes the wireless radios and hardware required to deliver the data to the CB-EMS software.

DMMS is continuously working on new ways to obtain the parameters needed for CB-EMS to operate. For each new hardware package, CB-EMS must be programmed to interface with each new type of interface hardware as they become available. Each hardware package that is currently deployed as part of CB-EMS is described in the following sections. As new packages are available, they will be added to this document.

4.1.1 3eTI T1, T3, T4

The first implementation at CBITEC used a system developed by 3eTI using Shark power meters and an ATOM controller for sensor input. This architecture is part of the DMMS, which includes the hardware architecture and communications model that provides the data for CB-EMS to display. The Shark power meters and ATOM controller use Modbus TCP to communicate with CB-EMS to provide data.

4.1.2 Direct Sensor Connections

To create a more flexible system than the 3eTI and Future Capabilities Integration Laboratory (FCIL) implementations, direct connections to other commercial-off-the-shelf equipment have been developed. This allows a more versatile system to be deployed by allowing individual sensors to be interfaced with CB-EMS instead of packaged systems like the 3eTI DMMS boxes and BCIL LabVIEW system. This eliminates the need for a third-party integrator to provide these data to CB-EMS in another form.

The most convenient way to communicate with additional sensors is to use Modbus TCP, which is a protocol that allows industrial sensors to communicate with SCADA systems. The “B-Mesh” that is included as part of the 3eTI DMMS provides a secure TCP/IP network that allows CB-EMS to communicate with any network-enabled device, including those that use Modbus. The B-Mesh uses the same encrypted radios that are provided for the rest of the 3eTI system to deliver secure information from the DMMS boxes. A few meters and data acquisition systems have been interfaced with CB-EMS directly and are listed below.

Multiple sensors can be combined into one interface box for convenience and to reduce the number of wireless radios necessary. A simple network hub is used in conjunction with the wireless radio in this instance.

4.1.2.1 3eTI T1, T3, T4

The first implementation at CBITEC used a system developed by 3eTI using Shark power meters and an ATOM controller for sensor input. Initially, these metering boxes communicated through a JACE interface and required a custom communications protocol. Later on, CB-EMS was programmed to communicate with them directly so that the JACE hardware and OBIX server could be removed from the system. The Shark power meters and ATOM controller use Modbus TCP to communicate with CB-EMS to provide data.

4.1.2.2 Electro Industries Shark Power Meter

Shark power meters from Electro Industries (Figure 15) are used at both BCIL and within the 3eTI DMMS boxes to measure power. These meters can communicate directly with CB-EMS, and that capability has been programmed into CB-EMS and tested. The Shark model 50, 100, and 200 power meters share the same Modbus addressing and therefore can all be used with CB-EMS. CB-EMS configures the connections to the meters automatically when they are set up. These connect through the Ethernet network and communicate with CB-EMS using Modbus.

Figure 15. Shark meter.

4.1.2.3 DENT PowerScout

The DENT PowerScout 3037 meter (Figure 16) was the first DENT meter capable of using Modbus TCP tested at CBITEC. This meter has three current measurements for one three-phase circuit. This meter is also capable of communicating directly with CB-EMS, and that capability has been programmed into CB-EMS and tested. This connects through the Ethernet network and communicates with CB-EMS using Modbus. CB-EMS configures the connections to the meters automatically when they are set up.

More PowerScout meters were added to the DENT PowerScout lineup, including the PowerScout 12, PowerScout 24, and PowerScout 48. These meters use an expanded Modbus map from the PowerScout 3037 and provide 12, 24, and 48 current monitors for 4, 8, and 16 three-phase circuits. These meter types were added and tested when they were released. These connect through the Ethernet network and communicate with CB-EMS using Modbus. CB-EMS configures the connections to the meters automatically when they are set up.

Newer DENT PowerScout meters were added to replace the original PowerScout lineup in 2017. These meters have been added to CB-EMS as well. This includes the PowerScout HD, PowerScout 12 HD, PowerScout 24 HD, and PowerScout 48 HD, which have 3, 12, 24, and 48 channels, similar to the original PowerScout series. These connect through the Ethernet network and communicate with CB-EMS using Modbus. CB-EMS configures the connections to the meters automatically when they are set up.

Figure 16. DENT PowerScout 3037.

4.1.2.4 LabJack T7

The LabJack T7 (Figure 17) is a data acquisition device that has up to 14 analog input channels and 12 digital input channels in the configurations produced for the DMMS. It can be packaged with a custom-developed interface circuit board (Figure 17) that makes it simpler to connect a wide variety of sensors to be used with CB-EMS. CB-EMS has been programmed to allow the LabJack T7 to connect to most analog signals, including 0–20 mA, 4–20 mA, 0–5 V, 0–10 V, and more. The sensor is scaled within the CB-EMS software and therefore is very flexible. The LabJack T7 communicates via Modbus and can be connected to CB-EMS through the same Ethernet network as other sensors described in this section.

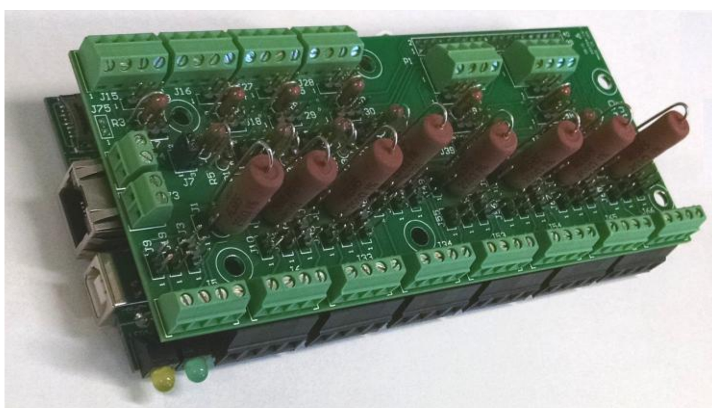

Figure 17. LabJack T7 with compact interface.

4.1.2.5 SEL 2411 Power Meter

The SEL 2411 power meter from Schweitzer Engineering Laboratories (Figure 18**Error! Reference source not found.**) is a robust power meter that is well suited for harsh environments. These meters can communicate directly with CB-EMS, and that capability has been programmed into CB-EMS and tested. CB-EMS configures the connections to the meters automatically when they are set up. These connect through the Ethernet network and communicate with CB-EMS using Modbus.

Figure 18. SEL 2411 power meter.

4.1.2.6 Cummins AMMPS Modbus Interface

Cummins Advanced Medium Mobile Power Sources (AMMPS) generators that are purchased by the U.S. Army include a control computer that measures all parameters desired by CB-EMS. DMMS staff worked with Cummins to provide an interface to their control computer to provide CB-EMS with these data without using a separate metering box. This is accomplished using an Axiomatic AX141800 interface that converts the Cummins proprietary protocol into Modbus TCP. CB-EMS configures the connections to the meters automatically when they are set up. These connect through the Ethernet network and communicate with CB-EMS using Modbus.

Figure 19. AMMPS.

4.2 Installation Setup Page

The Installation Setup page depicts how the administrator should provide the information to configure CB-EMS. It is available in the top menu bar under *Command* > *Installation Definitions* (Figure 20).

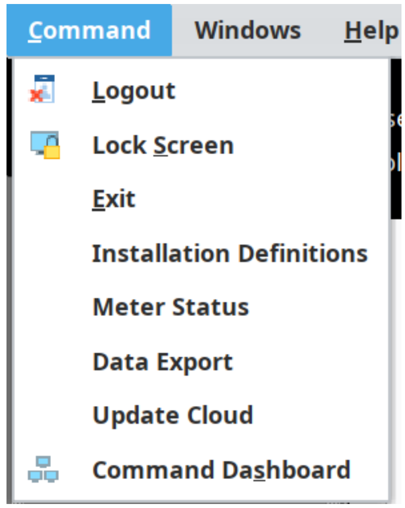

Figure 20. Command menu.

Selecting *Installation Definitions* from this menu will open the Installation Setup page. System setup takes place using this window.

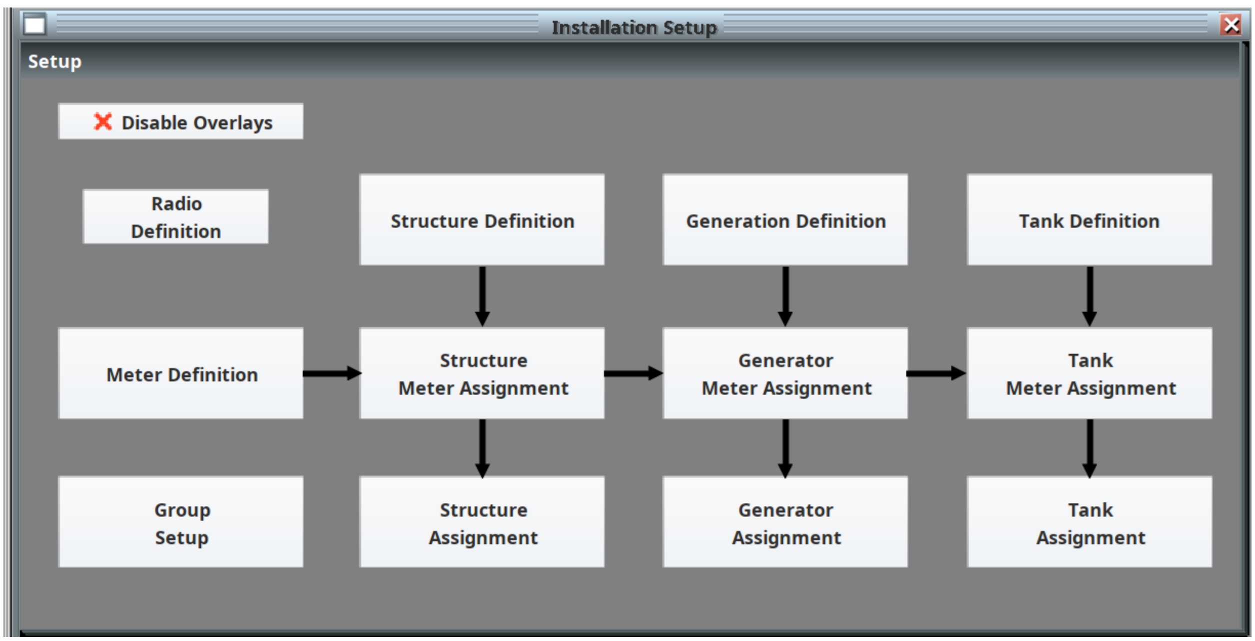

Figure 21. Installation Setup page.

4.2.1 Meter Definition

Defining meters is the first step in configuring the installation. Each meter in the system must be set up before it can be connected to a structure, generator, or fuel tank. Clicking the *Meter Definition* button will open a table (Figure 22) that shows the meters that have already been configured in the system.

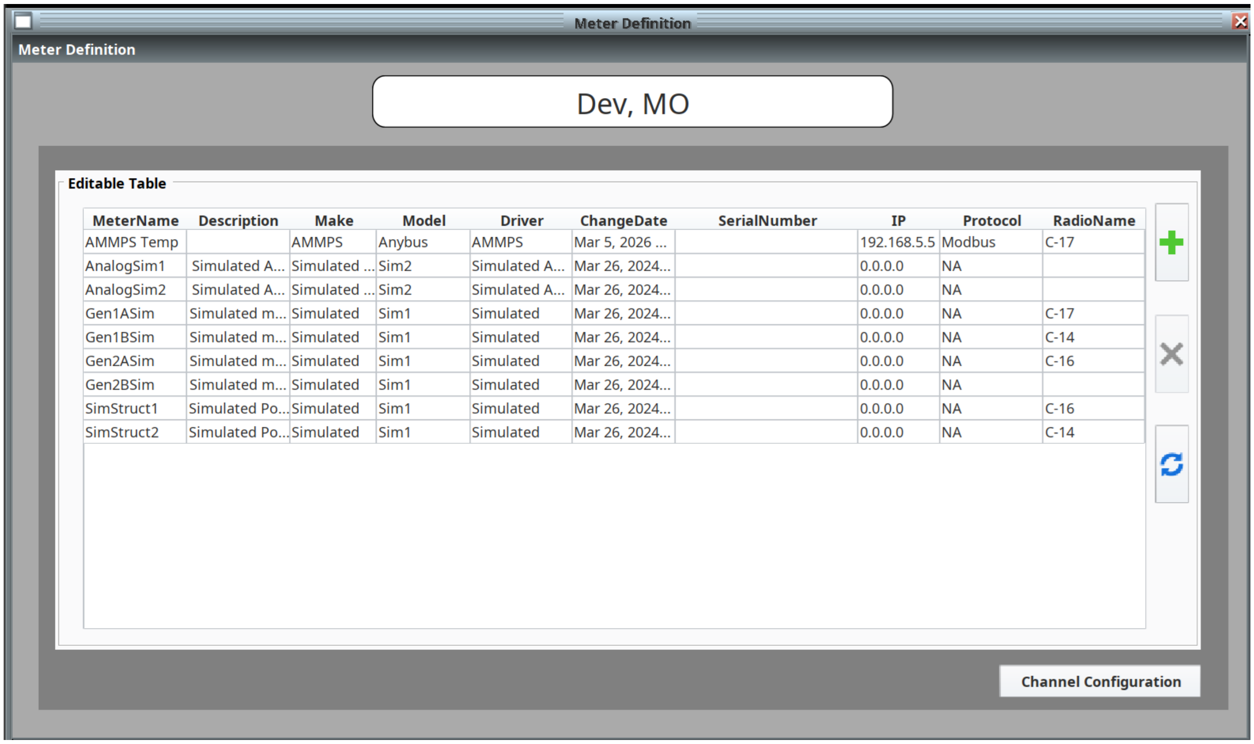

Figure 22. Meter Definition table.

Some of the fields in this table can be modified to make corrections as needed. However, some fields, such as MeterName, are not editable since they provide connections to the rest of the system and must remain the same. If any of those fields must be corrected, the meter must be removed and re-added. To remove a meter, select a meter and click the red x button. Click the refresh button (circular blue arrows) to verify that the changes have been inserted into the database. To add a new meter, click the green plus button to open the Meter Definition window (Figure 23).

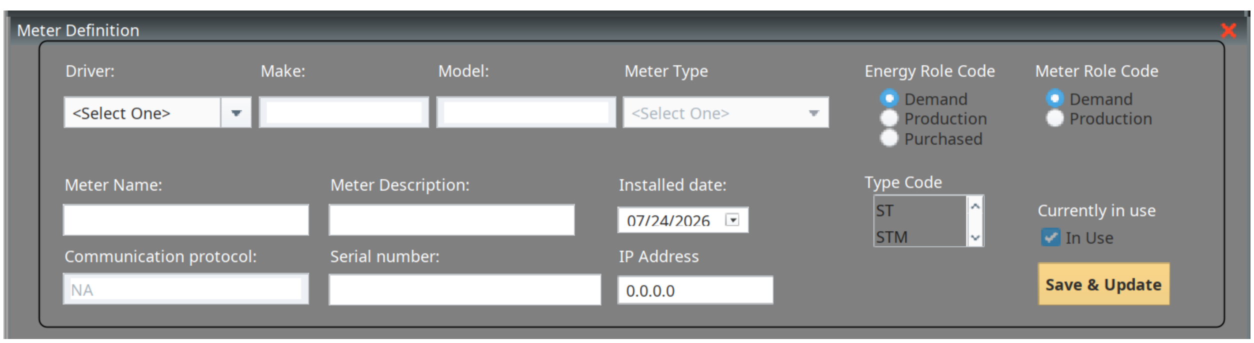

Figure 23. Meter Definition -window.

On this form, the Driver category defines which meter is being set up. By selecting the driver, the Make, Model, and Meter Type are automatically configured. Only the meters that have been written into CB-EMS are in the Driver list. For those sensors that use Modbus TCP to communicate, such as the DENT PowerScout, Shark, and LabJack, the IP address is used to communicate with the device and must be set correctly. All the other fields on this page are to be filled out at the administrator’s discretion. They are recorded in the database to help users identify sensors and to aid in troubleshooting. They are not used by the software in the analysis or display of sensors.

For analog channels to display engineering units, each channel must be mapped in the channel configuration utility. On the meter definition page, click the Channel Configuration button. This will bring up the dialog box (Figure 24). Select the meter and channel of a sensor connected by an analog channel to be configured. In the dialog box, you can hit refresh to populate the page with the current settings of that channel. To set the channel configuration, set the Title of the sensor, Units, and the calibration settings. The calibration settings use a two-point interpolation common amongst most sensors, where the voltage output from the sensor (often 0–5 V or 0–10 V) is mapped to the engineering value. For example, for a pressure sensor that has a range of 0–1000 psi and an output of 0–10 Vdc you would input 0 for Low Voltage, 10 for High Voltage, 0 for Low Value and 1000 for High Value. Once the correct values are input into the dialog box, click *Update* to make the change to the system. This mapping will allow CB-EMS to display the sensor in engineering units.

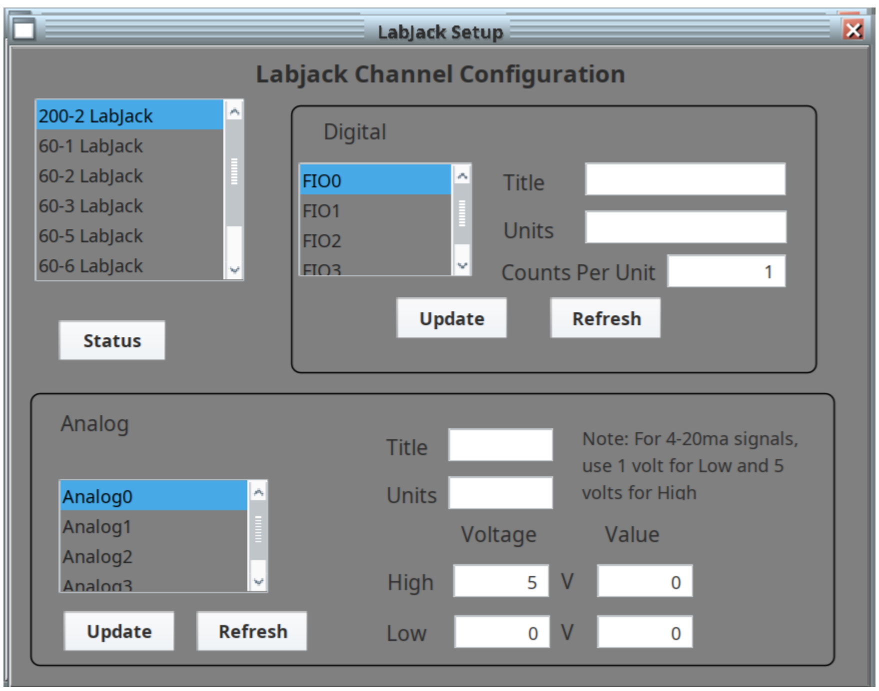

Figure 24. Channel Configuration dialog box.

4.2.2 Structure Definition

Structures are used to define all tents, buildings, or any other equipment that should be monitored for power, temperature, and/or auxiliary sensors. Clicking the *Structure Definition* button on the Installation Setup (Figure 21) page will open a table (Figure 25) with all previously defined structures.

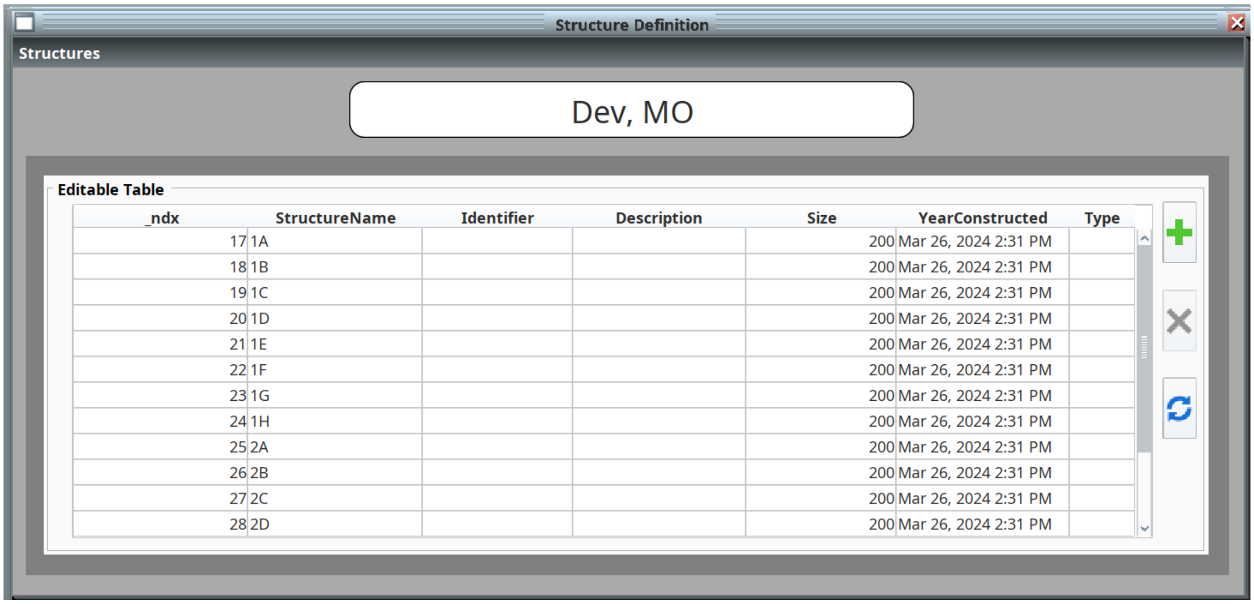

Figure 25. Structure Definition table.

As with the Meter Definition window, selecting a row and clicking the red x button will delete the currently selected structure. Clicking the button with blue circular arrows will refresh the table from the database, and clicking the green plus button will open the window shown in Figure 26, where you can define a new structure.

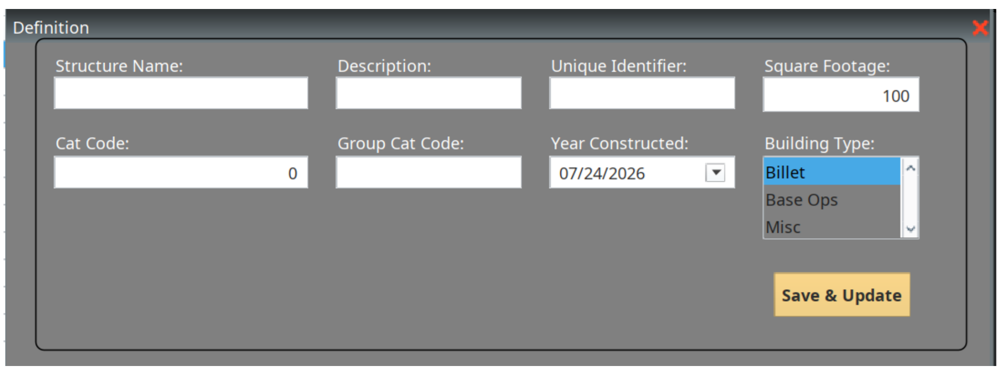

Figure 26. Structure Configuration window.

The Structure Configuration window provides the administrator with a method to define each structure to be monitored. In this window, the building name, type, area, and other parameters are recorded in the system. Square Footage is used by the system to calculate the building efficiency, and all other fields are used by the administrator and user to identify equipment. Each structure must be added to the system so that meters can be assigned to those structures as described in the following sections.

4.2.3 Structure Meter Assignment

Once the structures and meters have been entered into the system, the meters and sensors must be associated with the structure to enable the system to display those sensors. Clicking the *Structure Meter Assignment* button on the Installation Setup page (Figure 21) will open a window (Figure 27) designed to associate meters and sensors with the structures to which they attach.

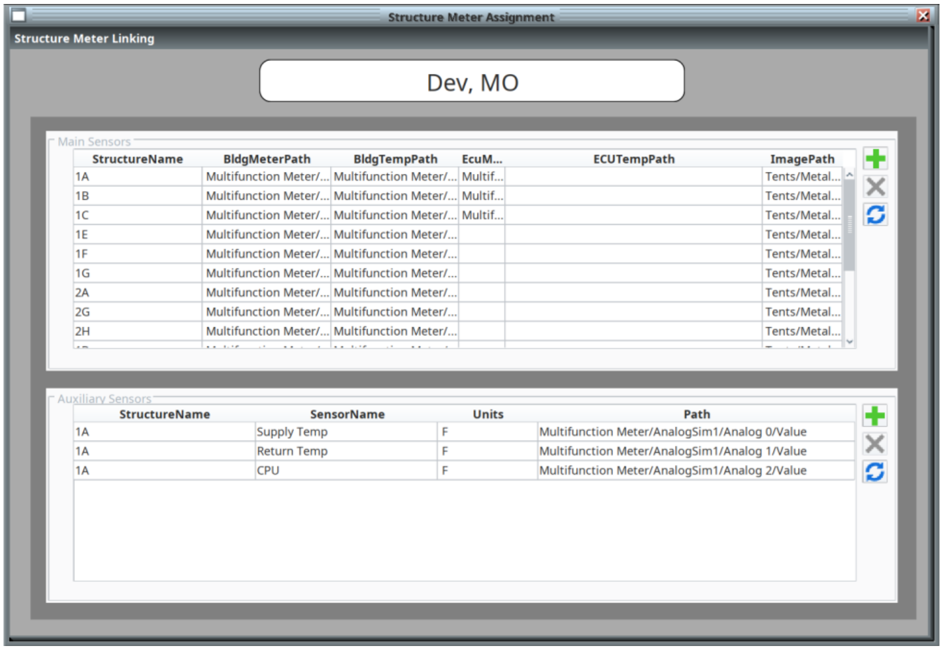

Figure 27. Structure Meter Assignment window.

As with the meter and structure definition windows, selecting a row and clicking the red x button will delete the selected structure. Clicking the button with the circular blue arrows will refresh the table from the database, and clicking the green plus button will open the Structure Meter Linking window (Figure 28), where you can define a new structure meter assignment.

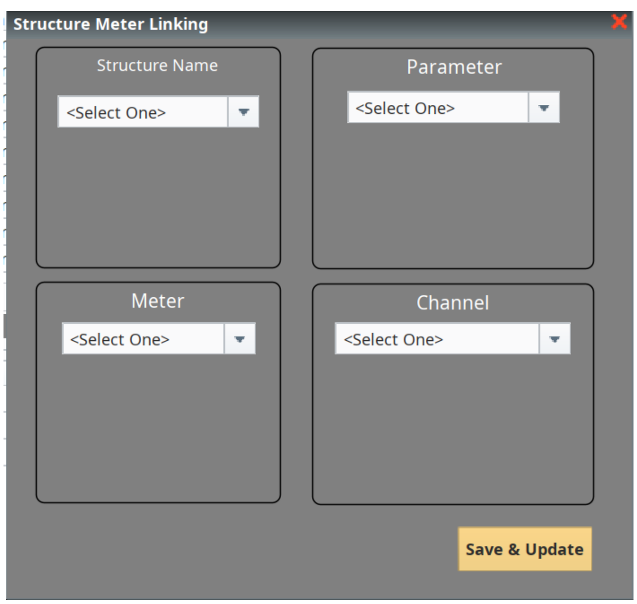

Figure 28. Structure Meter Linking window.

The Structure Meter Linking window (Figure 28) allows you to associate a number of sensors with the structure. First, select a structure under *Structure Name* to associate a sensor. Next, select the type of sensor being used under the *Parameter* heading. This can be a Building Power Meter, ECU Power Meter, Temperature Sensor, ECU Temperature Sensor, or Auxiliary Sensor. Third, select the meter that provides that input under *Meter*. Finally choose the channel associated with that sensor, if applicable, under *Channel*. Once you have made your selections, click *Save and Update* to connect that sensor to that structure.

ECU Power and Building Power are stored separately for a structure and allow the user to monitor the power consumption of those two loads. This represents the power consumed by the electronic control unit (ECU) and the rest of the building, respectively. The temperature sensor records the temperature of the structure itself. ECU Temperature can be used to monitor the outlet temperature of the ECU, thus providing more information on the health of the ECU. Auxiliary can be used to assign any other sensor input to a structure for analysis.

4.2.4 Structure Assignment

Once the meters have been assigned to structures, the next step is to position them on the site map and assign a relevant icon. Clicking the *Structure Assignment* button on the Installation Setup page (Figure 21) will open a window (Figure 29) designed to associate each structure with a group, if desired, and an image to represent it. Map location is no longer used, but it is left for backwards compatibility.

Figure 29. Structure Assignment window.

In the Structure Assignment window, the administrator can assign an image to the structure as well as assign a structure to a group. The image helps make the map more representative of the physical layout of the camp. A structure assigned to a group allows for easier access to the structure in other windows and allows groups of structures to be analyzed together. Once an image is assigned to a structure, the administrator can go back to the Camp page in Ignition Designer and adjust the IconAngle and Stretch parameters of each template to make the display more representative of the camp.

4.2.5 Generator Definition

Similar to the structures, generators are also monitored and must be set up accordingly. Generation assets can be diesel generators, photovoltaic arrays, or any other system used to generate electricity that should be monitored. Click the *Generator Definition* button on the Installation Setup page (Figure 21) to set up the generators (Figure 30).

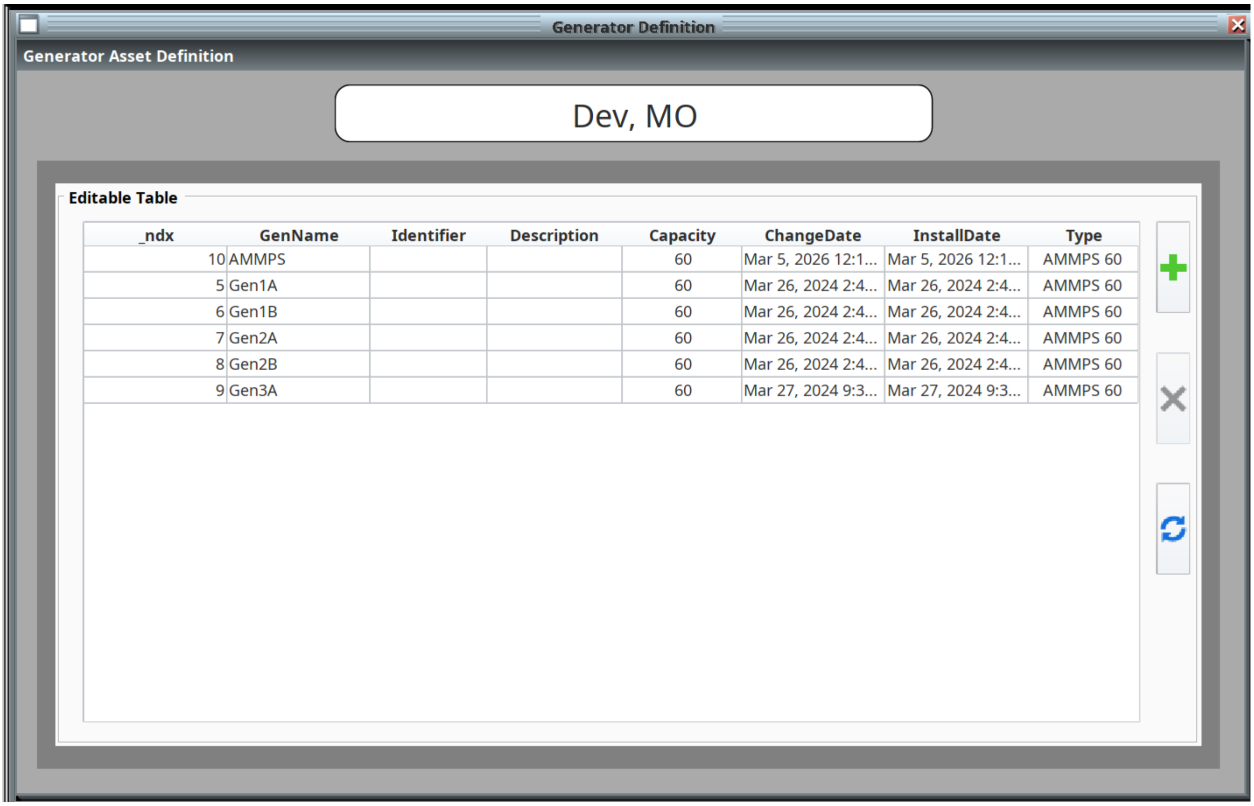

Figure 30. Generator asset definitions.

As with meters and structures, clicking the red x button will delete the selected generator, and clicking the button with the circular blue arrows will refresh the table from the system. Clicking the green plus sign will open the Generator Definition window where you can add a new generator to the system (Figure 31).

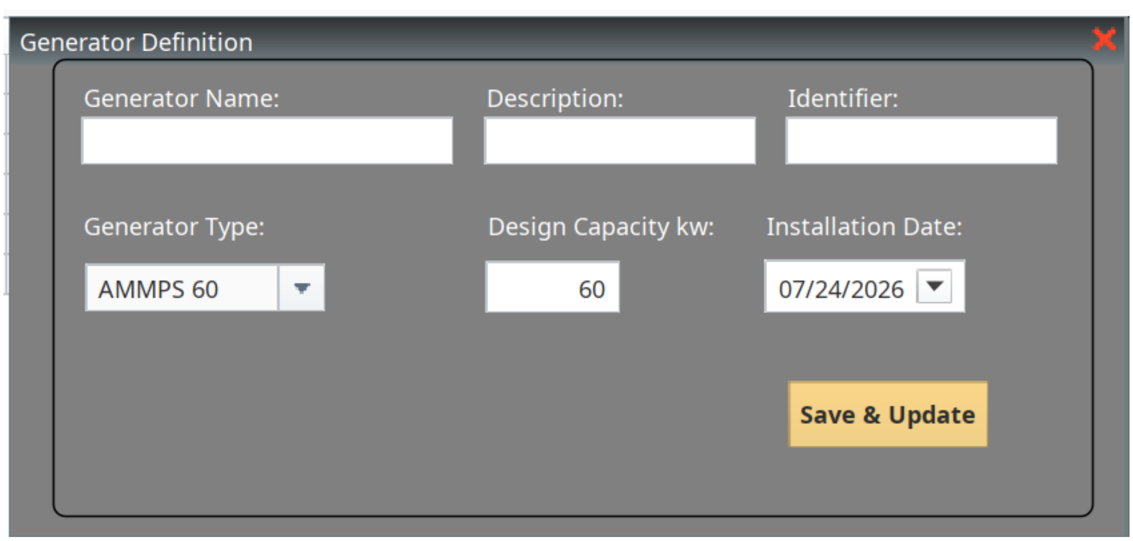

Figure 31. Generator Definition window.

The Generator Definition window provides a form to create new generation assets. Each generator should be given a name, description, identifier, type, and capacity. The Design Capacity field is used to determine the generator loading, and all other fields are used for identification. Generators must be set up on this page before they can be assigned meters to monitor their power output.

4.2.6 Generator Meter Assignment

Once a generator is entered into the system, it can be associated with a meter. To assign a meter to a generator, click the *Generator Meter Assignment* button on the Installation Setup page (Figure 21), which will open a table that lists the generator meter associations (Figure 32)

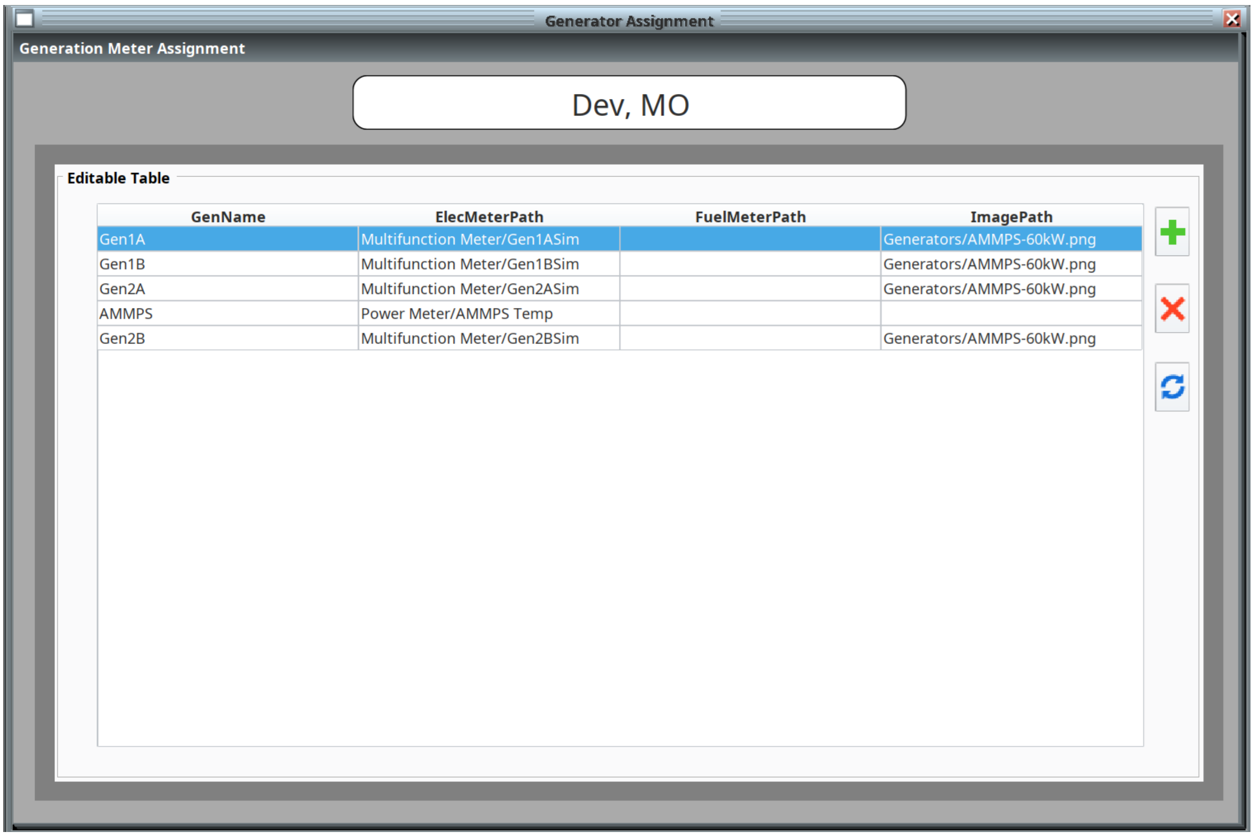

Figure 32. Generator asset meter assignment.

As with the other windows, selecting a row and clicking the red x button will delete the selected meter assignment. Clicking the button with the circular blue arrows will refresh the table from the database, and clicking the green plus sign button will open the Generation Metering window (Figure 33), where you can assign a meter to a generator asset.

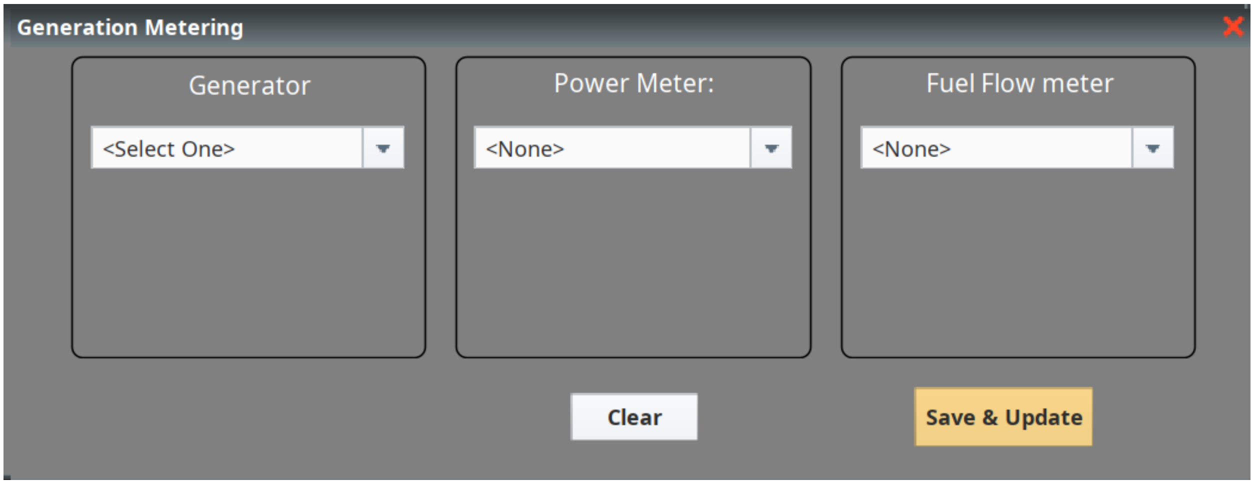

Figure 33. Generation Meter Linking

The Generation Metering window allows you to link a power meter to a generator. If fuel flow is being measured, a fuel flow meter can then be selected. Clicking the *Save & Update* button will add the link to the system.

4.2.7 Generator Assignment

Once the generators are linked to their associated meters, they should be assigned an image in order to be displayed on the map. The Generator Assignment window is also accessed from the Installation Setup page (Figure 21). Clicking the associated button will open the Generator Assignment window (Figure 34), which allows you to associate a generator with an image and a group.

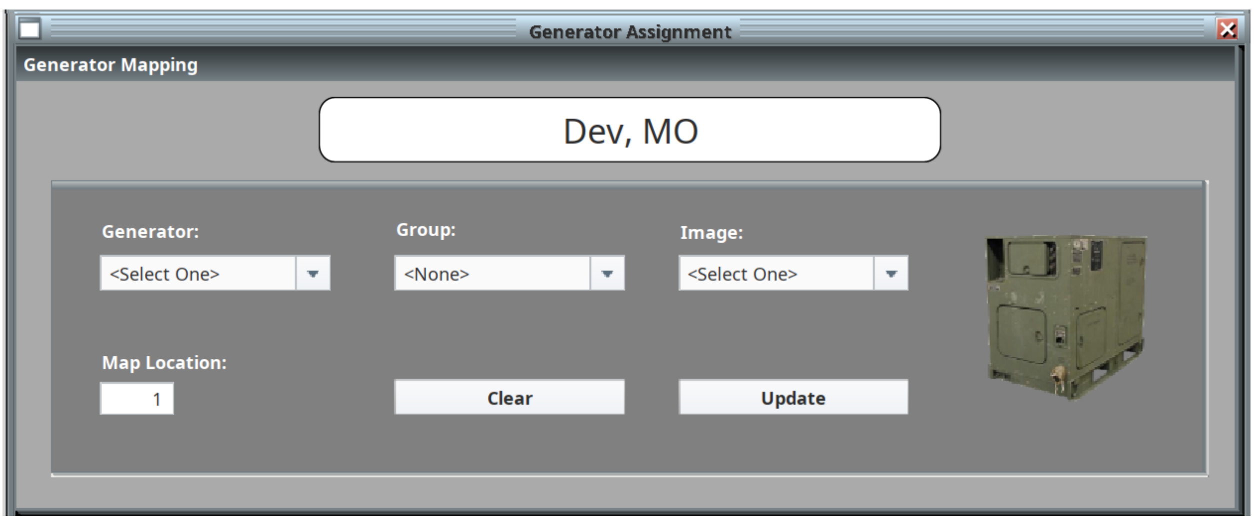

Figure 34. Generator Assignment window.

In the Generator Assignment window, the administrator can assign an image to the generator as well as assign a generator to a group. The image helps make the map more representative of the physical layout of the camp. A generator assigned to a group allows for easier access to the generator in other windows and allows groups of generators to be analyzed together.

4.2.8 Tank Definition

The tank definition process is the same as for the structures and generators. Tanks can be added using the Tank Definition button on the Installation Setup page (Figure 21).

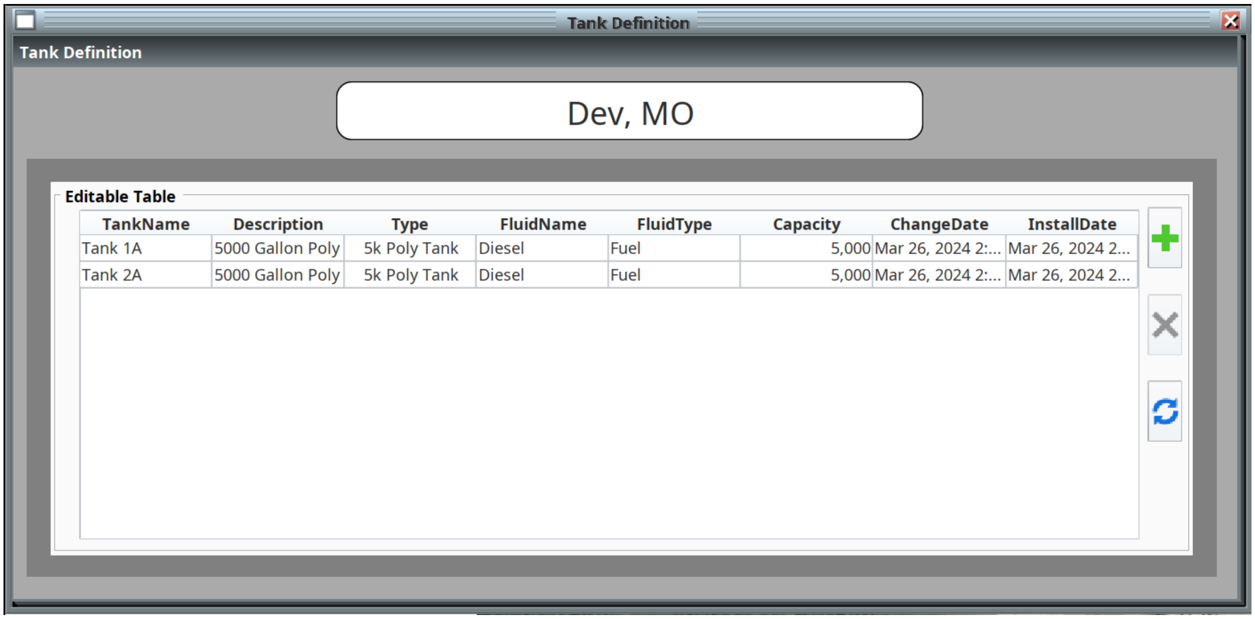

Figure 35. Tank asset definition.

As with the other pages, selecting a row and clicking the red x button will delete the selected tank. Clicking the button with he circular blue arrows will refresh the table from the database. Clicking the green plus sign button will open the Tank Definition window (Figure 36), where you can add a tank to the system.

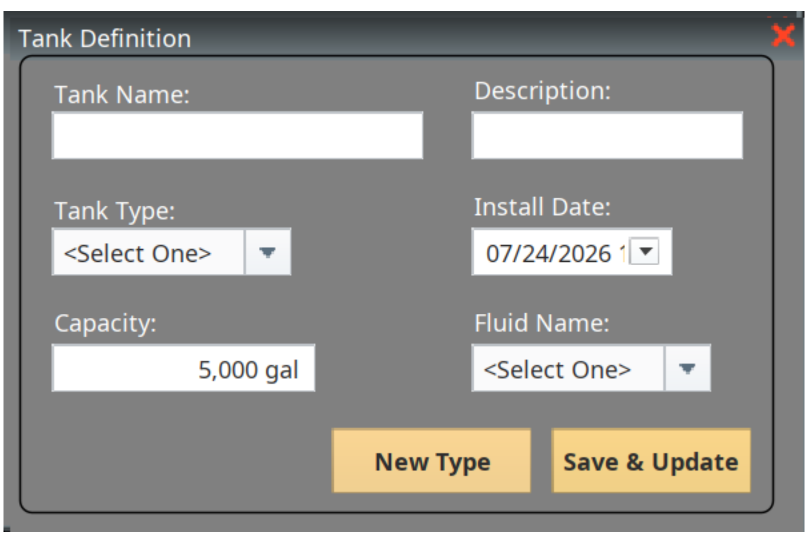

Figure 36. Tank Definition window.

The Tank Definition page gives the user the opportunity to define the characteristics of a storage tank to be monitored. Tank types must be set up in the database to document each type of tank. Each tank type includes equations that relate the fluid level to the tank volume. The Tank Name and Description fields are used to identify storage tanks as they are deployed. The fluid name can also be specified to aid the user in monitoring the tanks. As with the other windows, clicking *Save & Update* will add the tank information to the system. If a tank type is not listed in the dropdown, a new type can be added using the *New Type* button, which is defined using similar windows to all other functions.

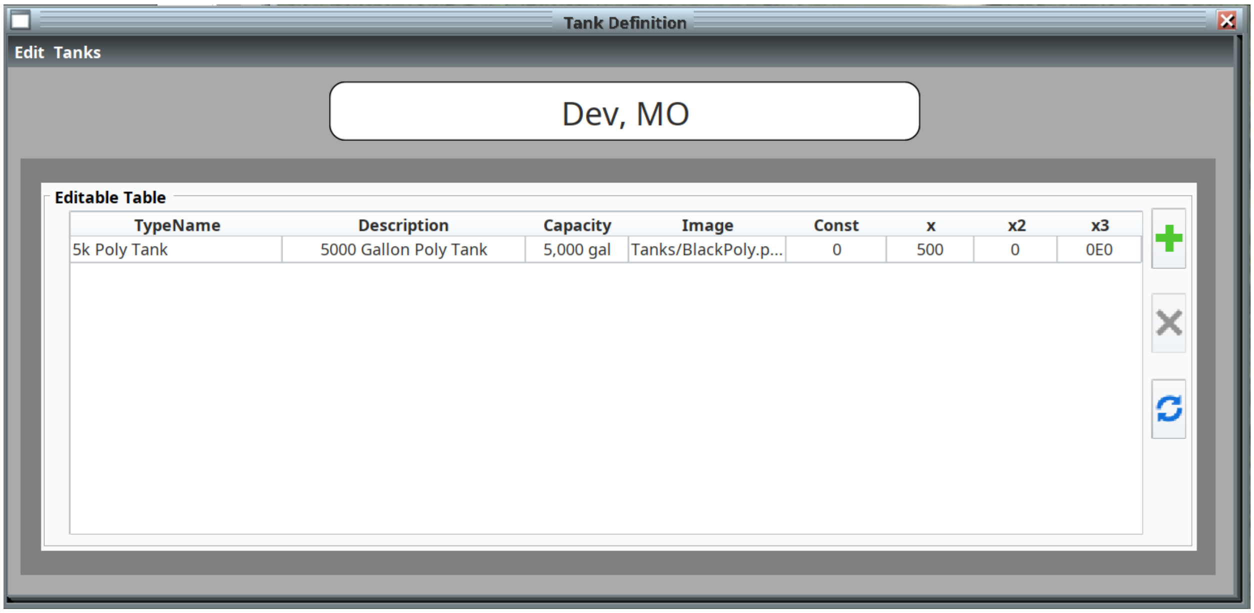

Figure 37. Tank Definition page.

As with the other pages, selecting a row and clicking the red x button will delete the selected tank type. Clicking the button with the circular blue arrows will refresh the table from the database. Clicking the green plus sign button will open the Add Tank Type window (Figure 38**Error! Reference source not found.**), where you can add a tank to the system.

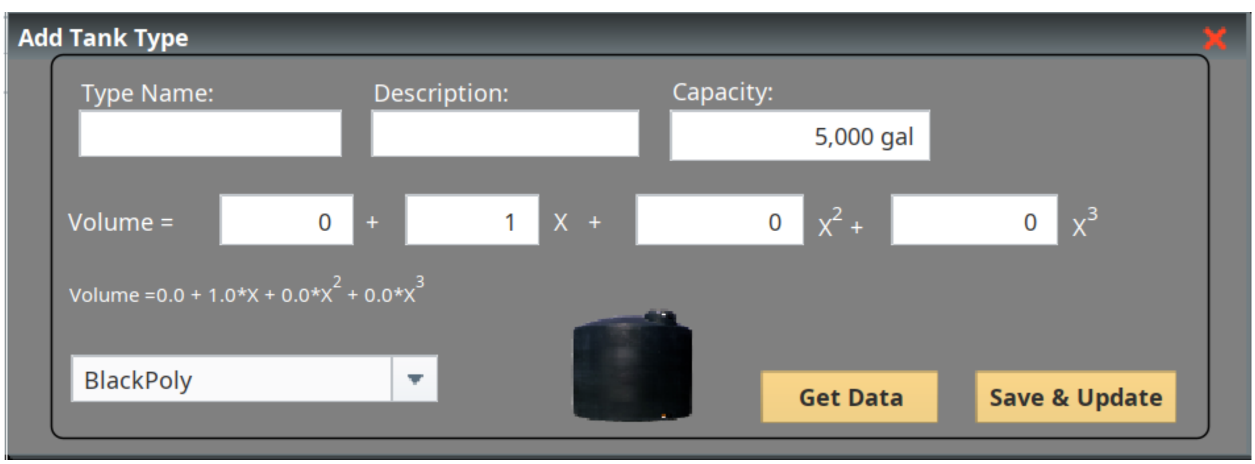

Figure 38. Add Tank Type window.

On this page, you can define the tank type, including the description, capacity, image, and equation to convert the raw analog signal from the sensor to engineering units. Generally, it is easy to create a conversion for industrial tanks with a float or ultrasonic level sensor as it's a linear relationship. Testing showed that a 3rd order polynomial provided good volume data for a pressure sensor in a flexible bladder fuel tank. If you know the conversion equation, you can input the data for a 3rd order polynomial to define the conversion. If you don't know the conversion equation, the *Get Data* button will provide a utility to create the conversion shown in Figure 39.

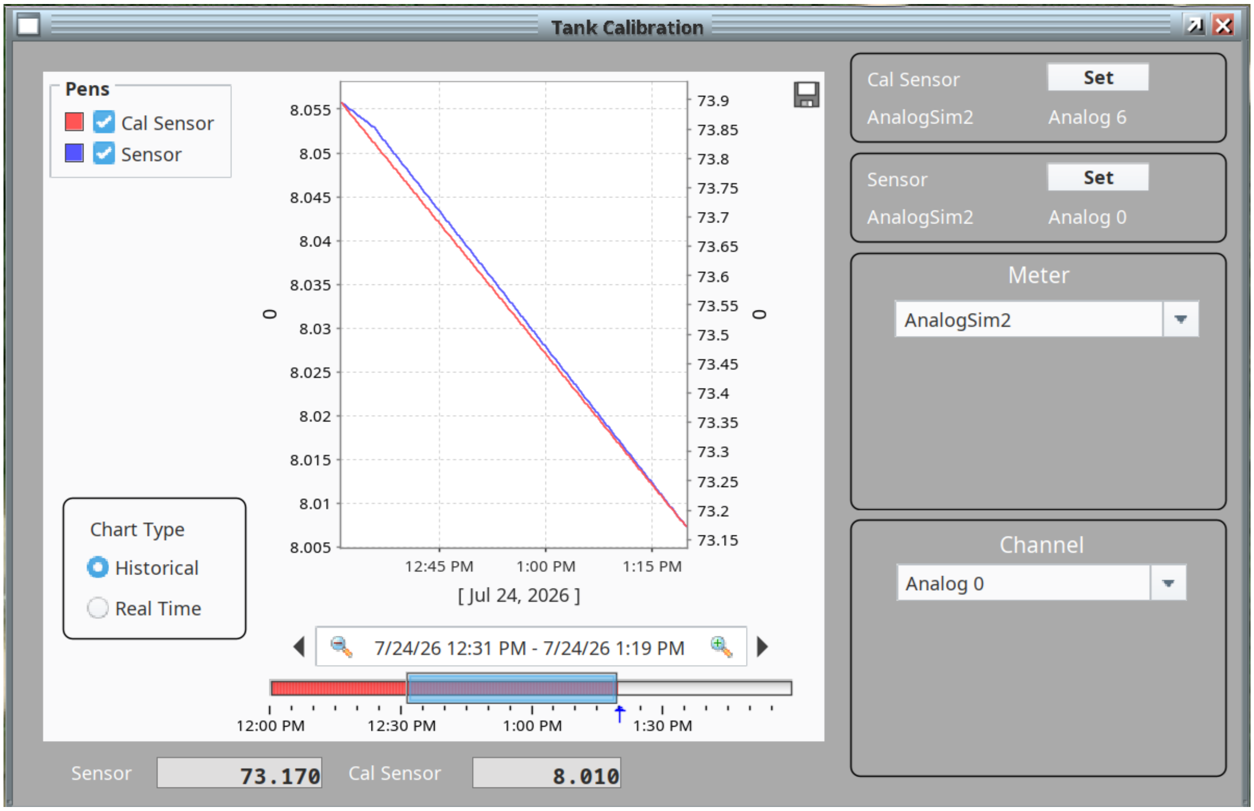

Figure 39. Tank type calibration tool.

To use this tool, you must have a sensor connected to the system that measures the volume of fluid added as well as the level sensor to be used during operations. Use the *Meter* and *Channel* dropdowns to select the sensors used to create the calibration curve. Click the *Set* button in the Cal Sensor block to set the channel used to measure the volume of fluid. Click the *Set* button in the Sensor block to choose the sensor that will be used to monitor the tank during operations. Then, choose the date range in the chart to represent the test where data were recorded for both sensors. The *Save* button at the top will allow you to create a .csv file that you can load into a program like Excel to calculate the 3rd order polynomial coefficients.

4.2.9 Tank Asset Meter Assignment

Once a storage tank is added, a meter must be associated with it in order to measure the fluid level of the tank. Click the *Tank Meter Assignment* button on the Installation Setup window (Figure 21) to open the page (Figure 40) where a meter can be associated with a storage tank.

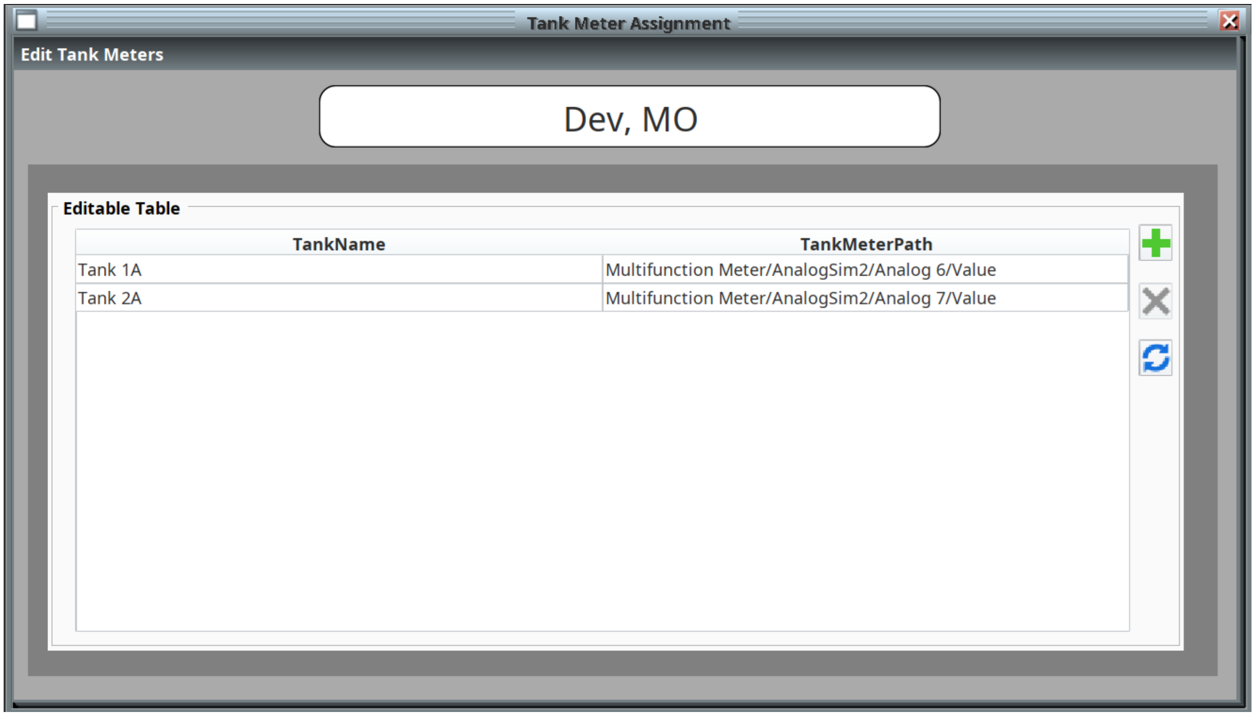

Figure 40. Tank Meter Assignment page.

As with the other windows, selecting a row and clicking the red x button will delete the selected meter assignment. Clicking the button with the circular blue arrows will refresh the table from the database. Clicking the green plus sign button will open the Tank Metering window (Figure 41), where you can assign a meter to a tank asset

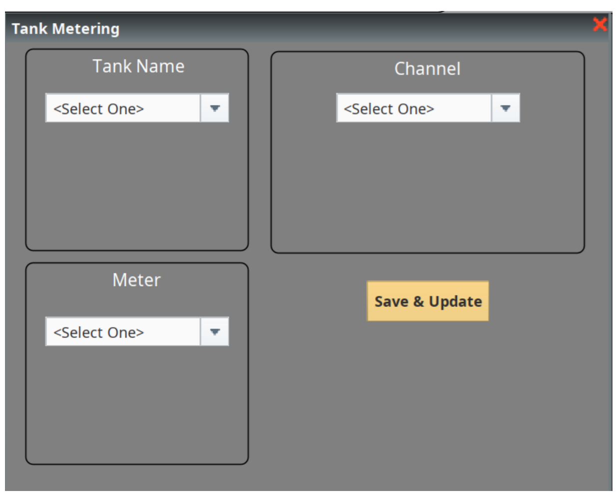

Figure 41. Tank Metering window.

The Tank Metering window allows you to link a meter to a storage tank. The sensor that is linked will provide fluid level information. Select the tank, meter, and channel to select the sensor that monitors this tank. Clicking the *Save & Update* button will add the link to the system.

4.2.10 Tank Assignment

The Tank Assignment window is also accessed from the Installation Setup page (Figure 21). Clicking the associated button will open the Tank Assignment window (Figure 42**Error! Reference source not found.**), which allows you to associate a tank with an image and a group.

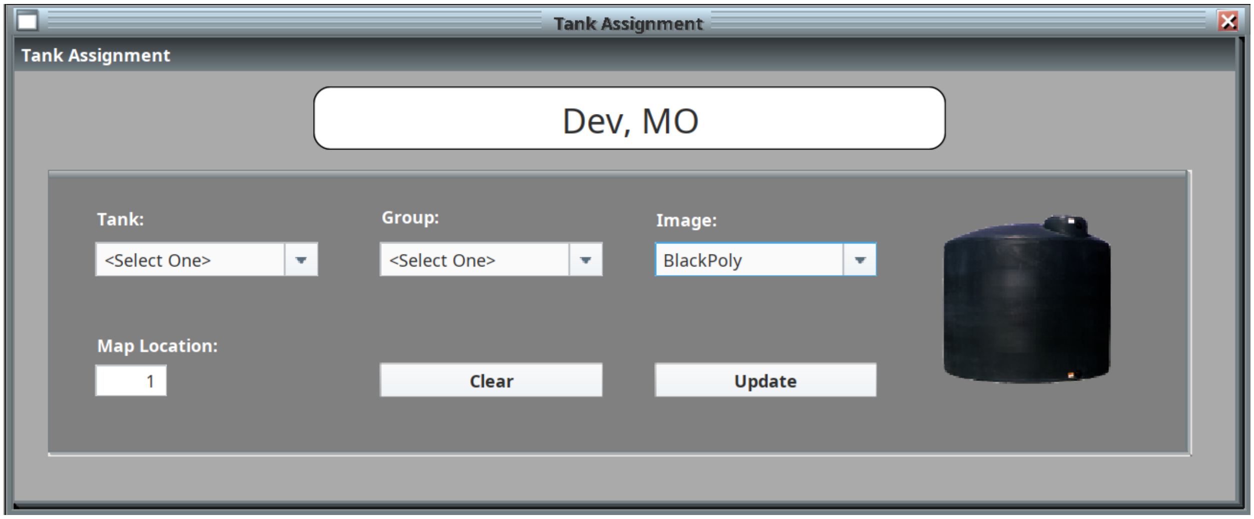

Figure 42. Tank Assignment window.

In the Tank Assignment window, the administrator can assign an image to the generator and assign a generator to a group. The image helps make the map more representative of the physical layout of the camp, and a tank assigned to a group allows for easier access to the tank in other windows and allows groups of tanks to be analyzed together.

4.3 Finishing Up

Once you are done adding and assigning all components of the system, it is a good time to verify that the dashboard represents the camp layout. If the sensors have been configured in DMMS and CB-EMS correctly, the data should be live on the dashboard screen. Verify that the data look correct. It is good practice to verify proper operation of sensors and meters by exercising the data values being measured. For instance, you can set the ECU that is being monitored to turn on and verify that the power draw from that ECU changes.

The installation setup is now complete. At any time, you can revisit any of the installation setup pages to add or remove any component from CB-EMS. You can now close the Installation Setup page and all other configuration windows; the system is ready for use.

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