Summary Report

Brandon Garage Electrification Plan
Winnipeg Transit

Siemens Canada Limited

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1 INTRODUCTION

Winnipeg Transit has identified the need for long-range battery electric buses (BEBs) and indicated its intention to first implement this technology at the Brandon Garage. As a result of preliminary discussions with Manitoba Hydro, it has been determined that there are electrical service capacity limitations at this site, which will affect the timeline and cost of implementing a zero-emissions bus fleet. Based on this situation and other potential constraining factors which will affect the scale-up of battery electric buses at the Brandon Garage, Winnipeg Transit has engaged Siemens to provide Professional Consulting Services to assess the ability of this site to support 105 operational BEBs, from an electrical infrastructure perspective.

Over the course of a 5-month period, the Siemens team methodically collected and analysed a variety of data provided by Winnipeg Transit, in order to ascertain the optimal electrical infrastructure solutions for the complete electrification of the Brandon Garage. Throughout the consultation, regular weekly meetings were held, and initial results continuously shared with the client. Thanks to the rapid and constructive feedback provided by Winnipeg Transit on each preliminary deliverable, the Siemens team was able to ensure that the results were in alignment with the objectives of the client's zero-emission goals. These goals included the desire to reduce the Greenhouse Gas (GHG) emissions of Winnipeg Transit's bus fleet, while maintaining the same level of service delivery, and optimizing capital as well as operating expenditures. In addition, a logical implementation plan was required, which had to be aligned with Winnipeg Transit's bus procurement schedule.

In order to support Winnipeg Transit with grid resilience, GHG reductions, and cost reductions, a Battery Energy Storage System (BESS), rooftop solar installation, and microgrid controller were recommended in the attached PSS®DE "Energy Twin" report. The required medium and low voltages upgrades are also discussed in detail, including a new Winnipeg Transit owned substation with much larger transformer, as well as several new low voltage switchboards. In terms of charging infrastructure, a total of 27 x 150 kW power cabinets and 105 x CCS1 dispensers will be required. These recommendations were made based on results provided via digital simulations, conducted by the Siemens DepotFinity and PSS®DE teams. Finally, a staged implementation plan was also provided and commented on. Several final scenarios, including the concept of a building expansion, were proposed to Winnipeg Transit. Further organizational reflection will be required, before Winnipeg Transit sets its final course of action for the electrification of the Brandon Garage.

In addition to this extended executive summary report, other major deliverables included the PSS®DE "Energy Twin" report, charging load profile simulations, electrical single line and equipment layout drawings, as well as a preliminary cable schedule. These documents together form the complete and final report supplied by Siemens, for this consultation project.

A special thank you to Erin Cooke for all her support and engagement on this project. Without the open and frequent dialogue which occurred between the Siemens team and Erin, the results of this consultation would not have had the same level of quality as what was achieved.

2 PROJECT BACKGROUND

As part of this project, Winnipeg Transit supported Siemens by providing the following key information:

- Simulated schedule for 105 battery electric buses.
- Battery capacity and energy consumption for each bus type.
- Detailed Utility bill and 12-month power demand summary.
- Q&A file numbering 100 items in total.

Winnipeg Transit is also faced with the following key constraints, as it relates to implementing this electrification work:

- Up until 2027, the maximum grid supply available to the Brandon Garage is 2500 kVA.
- The planned BEB procurement schedule is 15 buses per year, until 2027.
- A grid supply power deficit must be mitigated during 2026 and 2027, along with yearly grid outages.
- Layout and space constraints of the Brandon Garage must be managed.

2.1 Client provided data

Winnipeg Transit was highly supportive in terms of providing all required data, to enable Siemens to conduct this consultation in an effective manner.

The most important information shared was the simulated schedule for 105 battery electric buses, which would hypothetically operate out of the Brandon Garage. This schedule contained critical information including the bus type, pull-in and pull-out times, and total operating kilometres. It also contained both a Summer and Winter scenario, of which Siemens considered both when calculating the load profiles as well as conducting the PSS®DE "Energy Twin" simulation. It is worth mentioning that this schedule was based on typical service levels and not a reduced schedule, resulting from COVID-19 service delivery reductions. In addition to this schedule, key data points regarding the buses themselves were shared by Winnipeg Transit, including the battery capacity and energy consumption for each bus type. The provision of this information, and the completion of an additional checklist shared by Siemens, enabled the load profile calculations associated with the Winter and Summer scenarios. Additional items, including a detailed Utility bill and 12-month power demand summary, allowed the Energy Twin simulation to reflect reality as closely as possible. A previously completed PV assessment also enabled the Siemens team to verify that the results from our Energy Twin tool were in alignment with the conclusions of that report.

To support the drawing deliverables, the AutoCAD file for the existing Brandon Garage was shared, along with drawings of various types of BEBs which have the potential to be purchased for this project. This enabled Siemens to model the positioning of various infrastructure elements, with the utmost accuracy.

Finally, Winnipeg Transit and Siemens collaborated on an extensive Question & Answer file, which numbered 100 Items in total and covered a variety of topics which were pertinent to the development of the optimal infrastructure solution.

2.2 Critical assumptions & constraints

There are a handful of key constraints Winnipeg Transit is facing, which drove the solutions proposed as part of this consultation. First and foremost is the fact that up until 2027, the maximum grid supply available to the Brandon Garage is 2500 kVA, which is limited by the existing line from Manitoba Hydro and the maximum size of transformer they can provide. In order to achieve the BEB procurement schedule of 15 buses per year, a power supply deficit must be addressed in 2026 and 2027. The Brandon Garage also experiences several power outages per year, which must be mitigated. In addition to this, the layout and space constraints of the existing bus garage need to be managed, which does present a challenge when considering the space required for charging infrastructure, as well as the amount of time it takes to fully charge a long-range battery electric bus. It should also be noted that Winnipeg Transit had a few key operational constraints with respect to the setup of the new charging equipment, including the avoidance of underground cabling and the installation of charger power cabinets outside of the main bus bay. The potential solutions for each of these key topics will be discussed in the subsequent sections of this report.

3 CHARGING LOAD PROFILES & ENERGY TWIN

Based on the simulation work completed, the Siemens team has reached the following conclusions:

- The maximum power demand based on 105 operational BEBs and utilization of Smart Charging will be 4,030 kW.
- With a spare charging contingency of ~10%, the maximum anticipated demand will be 4,410 kW. This reflects all chargers outputting full power at the same time, as well as the building load.
- The recommended DER assets include 1.1MW of rooftop solar generation, a BESS with a capacity of 4.5-4.7 MWh for a 1-hour duration, as well as a microgrid controller to manage it all. Total CAPEX of approximately $4M CAD for this equipment.
- These DERs will ensure that Winnipeg Transit is able to meet its GHG reduction goals, while supporting the same level of service delivery and reducing capital as well as operating expenditures.

3.1 Peak power demand for the proposed charging solution

For the more intensive summer bus schedule, the peak power demand calculated for the charging of battery electric buses was 3,668 kW. Meanwhile, the power demand for the winter bus schedule was lower at 3,066 kW. Most of the charging occurs during the evening period, however there are also a sizable number of buses which return to the Brandon Garage midday, thus providing an opportunity for charging at this time. The simulated bus schedule provided by Winnipeg Transit considered four (4) major sets of pull-in and pull-out times for the buses, which the Siemens charging simulation team then modelled as four (4) individual sets of "trips". After these trips were modelled separately, the results were aggregated to calculate the overall peak power demand at the Brandon Garage. It should be noted that the peak power demand was achieved during the evening period, for both schedules.

Between June 2019 and July 2020, the maximum power demand to support all building service electrical loads at the Brandon Garage was 324 kW, as per Utility data provided by Manitoba Hydro. Based on discussions with Winnipeg Transit, it was estimated that the building's electrical services load at this site would modestly increase over time, to approximately 360 kW (400 kVA).

Considering the above information, the Siemens team assessed that the maximum power demand at this site will be in the range of 4,030 kW, or 4,478 kVA @ 0.9 Power Factor (PF). It should be noted that this peak power demand is taking into account the use of smart charging, which was considered by the Siemens charging simulation. As will be discussed in a forthcoming section, 27 x 150 kW power cabinets are being recommended. Therefore, without the use of any smart charging and with all 27 power cabinets operating at full power, along with a building load of 360 kW, the maximum power demand in this scenario would be approximately 4,410kW, or 4,900 kVA @ 0.9 PF. This difference between the managed and unmanaged charging load is approximately 10%, which means there is a "spare" charging availability equal to this amount, as well. As a result, Siemens recommends that Winnipeg Transit design and build the infrastructure to support the unmanaged load, to ensure that a spare charging contingency of 10% is available. It is worth reminding the reader at this point that these power demands are based on the schedule of Winnipeg Transit, which accounts for 105 battery electric buses being in active operation at any given time.

The raw data associated with these simulations is attached separately to this report and is also briefly discussed in the Appendix, under section 7.3. It should be mentioned that this raw data also includes the total amount of energy delivered to the battery electric buses for each "trip", measured in kilowatt-hours (kWh).

3.2 Charging schedule considerations & real-time optimization

As per the raw simulation data attached separately to this report, the Siemens charging simulation team also calculated several other variables relating to each bus including the battery State of Charge (SoC) start and end for each vehicle, as well as a verification of whether each bus will have sufficient energy for it's planned route. Winnipeg Transit has a number of buses which will engage in midday charging at the depot, which will allow them to complete their assigned blocks of work. In the simulation tool, all buses which were marked as not having enough energy for the planned route will receive midday charging and thus be able to complete their routes, in reality. To model the most intensive charging scenario and ensure that the infrastructure installed includes some degree of contingency, the SoC end target for every bus upon returning to the depot was set to 100%, even if this was not required for the bus to complete its route. So, even though some buses do not achieve this target in the simulation, we still assessed that they would have sufficient energy to complete their routes. It is possible that the peak power demand can be further optimized in implementation, by adjusting these SoC end targets.

Due to the layout constraints of the Brandon Garage and the dynamic nature of the midday charging which is planned here, the Siemens team recommends that the optimization of the BEB charging schedule occur in real time, via the use of software solutions which can intake data from a variety of vehicle and charging systems. This will be discussed in greater detail in section 5 of the report.

3.3 PSS®DE "Energy Twin" report

Once the charging load profiles were completed and compiled on a 15-minute interval basis, the Siemens PSS®DE "Energy Twin" team was engaged. This team's primary task was to model the optimal set of Distributed Energy Resources (DERs) which would enable the operation of 105 BEBs at the Brandon Garage. A highly detailed report of this work has already been provided to Winnipeg Transit, and having undergone several review cycles, is separately attached to this consultation deliverable package. The results of this team's work are summarized separately in that report, however it is worth repeating that the recommended assets included 1.1MW of rooftop solar generation, a BESS with a capacity of 4.5-4.7 MWh for a 1-hour duration, as well as a microgrid controller to manage it all. The approximate initial investment for these DERs is in the range of $4M CAD. In terms of benefits, details regarding how these DERs support with the deficit in grid source supply, reducing demand charges, as well as outage mitigation, are all described in this report. These DERs will also ensure that Winnipeg Transit is able to meet its GHG reduction goals, while supporting the same level of service delivery and reducing capital as well as operating expenditures.

4 REQUIRED ELECTRICAL INFRASTRUCTURE

Based on the consultation work completed, the following electrical infrastructure assets will be required for this project:

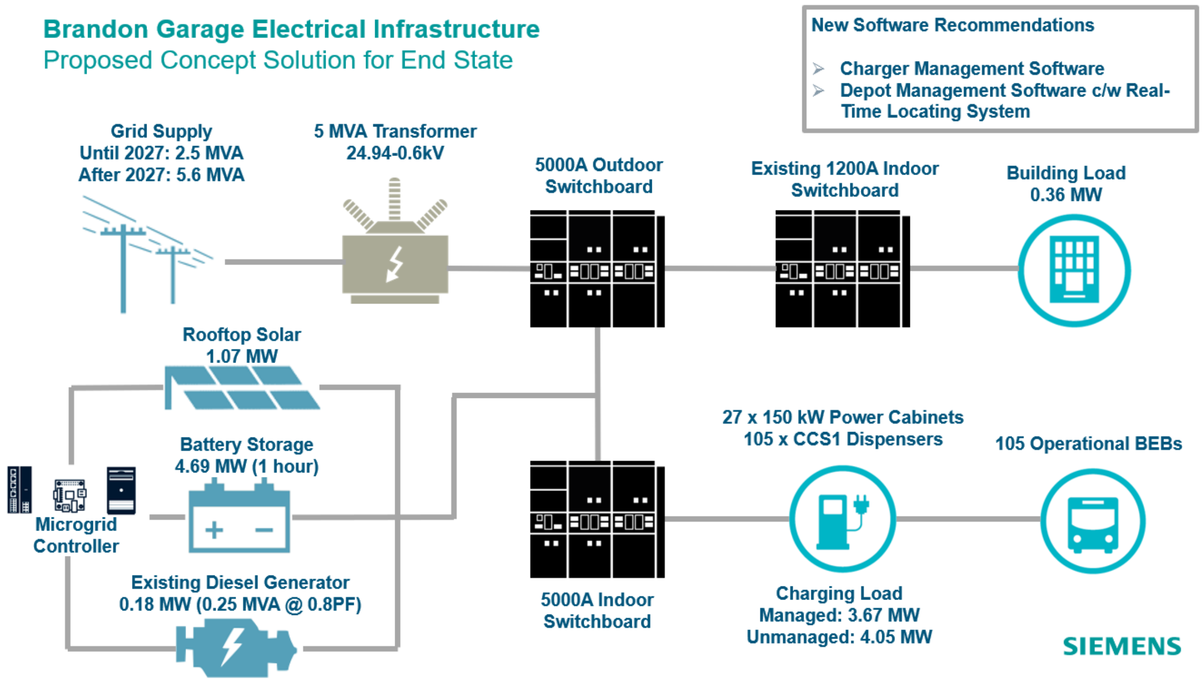

Figure 1 - Proposed Concept Solution for the Brandon Garage

4.1 Number, location, and type of chargers & dispensers

Based on the simulations run by the Siemens team, it was concluded that the optimal number of 150 kW DC power cabinets was 27. With this configuration, 24 of these cabinets would connect to 4 CCS1 dispensers each, while 3 of these cabinets would each connect to 3 CCS1 dispensers, for a total of 105 CCS1 dispensers serving 105 operational BEBs. An additional fourth dispenser could be connected to these last 3 power cabinets in case additional charging spots were desired, or for consistency.

In terms of the 150 kW power cabinet, this is the industry standard output power used for battery electric bus charging, in a depot. There are several reasons for this, including the fact that an air cooled CCS1 dispenser can still be used as opposed to heaver liquid cooler options, BEBs from all the major OEMs can readily accept this power rating, and because 150 kW still provides enough power to fully charge these batteries within an overnight charging window.

The approach of using power cabinets with remote dispensers is beneficial, as it allows the CAPEX intensive and larger power cabinets to be in a separate room, thus better protecting this equipment and reducing footprint constraints in the main bus bay. DC cabling can then be run to the smaller and less costly dispensers, which can be placed where the buses will park. This approach also allows for multiple CCS1 dispensers to be connected to each power cabinet for sequential charging, which allows the transit operator to maximize their investment. In the case of the Brandon Garage, CCS1 dispensers were preferred over pantographs. The primary reason for this is that both 40-foot and 60-foot buses are operated there, which presents a challenge when the pantograph needs to be precisely positioned overtop of the bus charging rails. The 25-foot CCS1 dispenser cord provides more flexibility to connect to either a 40- or 60-foot bus, regardless of exactly where it parks. While overhead cable reels were examined and could still be a feasible option with the advancement of these solutions, it was assessed that currently there is a limited number of reliable options. Thus, the proposal was to install CCS1 dispensers at ground level, while maintaining the option for overhead reels for evaluation, at time of implementation.

Another requirement communicated by Winnipeg Transit was to avoid having to dig up the existing floor of the Brandon Garage, to install underground cabling between the power cabinets and dispensers. With that in mind, the Siemens team proposed that the cabling be run along the ceiling of the garage and then be brought down to ground level via hollow steel posts, which the dispensers could also be directly mounted to. Further verification of this proposed solution is recommended to be completed during the detailed design stage of this project, to be sure of the optimal approach. For example, it is possible that the digging up of the existing floor may not end up costing that much more than the proposed solution, while also potentially shortening the overall cable runs.

In terms of where to install the power cabinets, there were two main options considered. The first was the storage room in the southeast corner of the Brandon Garage, where it was determined that sufficient space was available for all 27 power cabinets. The main electrical room is also located within this same area and the grid connection transformer is just outside the walls of this room. There are two potential challenges, however, with one being that the cable runs to the dispensers at the north end of the garage would be quite long, and the second being the desire of Winnipeg Transit to turn this area into a training room. The second power cabinet location seriously considered was along the east side of the building, near the existing offices. There is green space available here for a simple two-storey building expansion, where the second floor could accommodate the power cabinets and the first floor could be used for office space. The main benefits of this solution include the fact that cable runs are shortened, while also freeing up space for a training area within the existing storage room. It is possible that a hybrid solution is chosen in the end, wherein the first few power cabinets are installed in the storage room to support the electrification of the first BEBs, while the remainder are located in the new building expansion, once completed. This topic is discussed further in the preliminary cable schedule write-up, attached separately to this report.

A tertiary option to consider would be the placement of the power cabinets in the middle of the main bus bay, while running busway from the main switchboard to each power cabinet. This would significantly reduce cabling costs on the project but, may require a more substantial rearrangement of the bus bay lanes to accommodate the power cabinets.

4.2 Required electrical upgrades

In terms of the required electrical upgrades to support charging for 105 operational BEBs, the Siemens team recommends that a Winnipeg Transit owned medium voltage substation be installed, which will need to include a 5000 kVA transformer. Downstream of the transformer, a 600V outdoor switchboard is recommended. This switchboard will have separate feeders going to the new switchboard(s) dedicated to the charger loads, as well as to the existing 1200A switchboard servicing the building load. With this configuration, it is our recommendation to not at all alter or retrofit the existing 1200A switchboard servicing the building electrical loads. All these recommendations are also illustrated in the Single Line Diagram created by Siemens and attached to the report. With respect to the switchboards dedicated to the chargers themselves, the number and rating will depend on whether Winnipeg Transit elects to locate all 27 power cabinets in a single room, or not. If they are all on in one room, it has been assessed that a single 5000A switchboard could be used, with 27 feeder breakers to provide power to all chargers. If power cabinets are placed in separate rooms, it is recommended to install separate switchboards to support the power cabinets in each of those spaces.

While Winnipeg Transit and Manitoba Hydro have communicated a preference for a single grid connection transformer, Siemens recommends that the option of two (2), separate, smaller transformers be investigated. By having two (2) connections to the grid, each supporting half of the overall load, the fault current level in the system is cut in half and the redundancy at the site is increased. Redundancy could be further increased in the case that Manitoba Hydro were able to bring two (2) separate feeds to these transformers, however this was understood to not be possible at the time of writing this report.

The BESS and PV equipment recommendations are discussed in detail within the Energy Twin report. An Automatic Transfer Switch will need to be implemented, to facilitate connection between the BESS as well as PV sources and the loads at site.

5 SOFTWARE SOLUTIONS

Summary

At a minimum, Siemens is recommending that the following new software systems be implemented by Winnipeg Transit:

Software	Project Year of Initial Operation (assuming year 1 is 2023)	Why?
Charge Management Software	Year 1	For smart charging and operations management
Depot Management Software	Year 3	For parking management, once 20% spare ratio is exceeded
Real-Time Locating System	Year 3	For parking management, once 20% spare ratio is exceeded
Microgrid Controller Software	Year 4	For management of DERs, to mitigate grid supply deficit

A follow-up consultation focused on software is recommended, in order to confirm the above assumptions and also to ascertain what additional systems may be required to ensure a successful project.

Details

To ensure that this is a successful electrification project, Siemens recommends the optimization of existing Winnipeg Transit software systems, as well as the potential implementation of other commercially available tools. It is also recommended that these various systems be combined into a single integrated software solution, to ensure optimal operation of 105 battery electric buses at the Brandon garage.

From an electrical infrastructure perspective, the first layer of software which will support the reduction of both CAPEX and OPEX is the Charge Management Software, otherwise known as a CMS. The CMS will support a variety of functions including real-time status reporting of the charging, detailed charge transaction information, notifications for errors and other events which occur at site, as well as load management. CMS load management capabilities vary widely between vendors and can have simple or more sophisticated approaches to load management. Simple solutions include setting power limits for the site and ensuring that vehicles follow a pre-set strategy, such as First-In First-Out. On the other hand, these systems can also consider many additional operational factors including vehicle schedules, cost of energy, pre-conditioning requirements, and vehicle to route allocation. As we go down the path of more advanced optimization algorithms, the required data inputs from other systems also continues to grow and this is discussed in further detail, below. To round out the management of electrical infrastructure, a microgrid controller (MGC) and its associated intelligence is also required. The MGC is discussed in detail within the Energy Twin report, however, suffice to say that it manages the operation of Distributed Energy Resources such as Battery Energy Storage Systems, PV installations, and generators.

It was mentioned in the previous paragraph that more advanced load management algorithms require data from other telematics system operated by the transit agency, including the CAD/AVL system, vehicle scheduling software, and depot management system. The transfer of this data can be facilitated via the use of Application Programming Interfaces (APIs), which in layman's terms allow different software systems to speak with each other. In addition to these systems, a connection with the microgrid controller is also highly beneficial, as the additional sources of energy supply from the DERs can be accounted for, to provide optimal energy "operation" at site. Figure 1 below helps to illustrate the concept of such an integrated software solution, for the reader's benefit.

The Siemens team has assessed that a key aspect of any integrated software solution for a fully electrified bus garage must include a depot management system, in combination with a Real Time-Locating System (RTLS). Depot management systems are provided by a number of bus telematics software providers and support automatic vehicle-to-block assignment and vehicle parking within the depot, among other things. Meanwhile, the RTLS consists of wireless "gateways" placed throughout the garage, which are monitoring for signals received from active transponders on each bus. By combining the intelligence of a depot management system with the real-time positioning information of each bus, the integrated software solution for a given site can ensure that the right bus parks at the right dispenser for charging, thus enabling the bus to leave for its route on time. This is key since the time for bus fuelling dramatically increases in comparison to diesel and there are various charging processes to consider, such as sequential charging with multiple dispensers and pre-conditioning. With this in mind, it is crucial that information such as vehicle position, State of Charge (SOC), and route assignment is exchanged and optimized in real-time. With fast and efficient transfer of data between its various software systems, Winnipeg Transit can ensure that operations at the Brandon Garage will be intelligently managed.

As a next step, the Siemens team recommends that Winnipeg Transit conduct a follow-up consultation, for software solutions to support BEB garages. This study would help Winnipeg Transit to better understand whether it's current software systems will be able to support the needs of BEB operations, or if additional capabilities will need to be developed to ensure a smooth transition to this new bus technology.

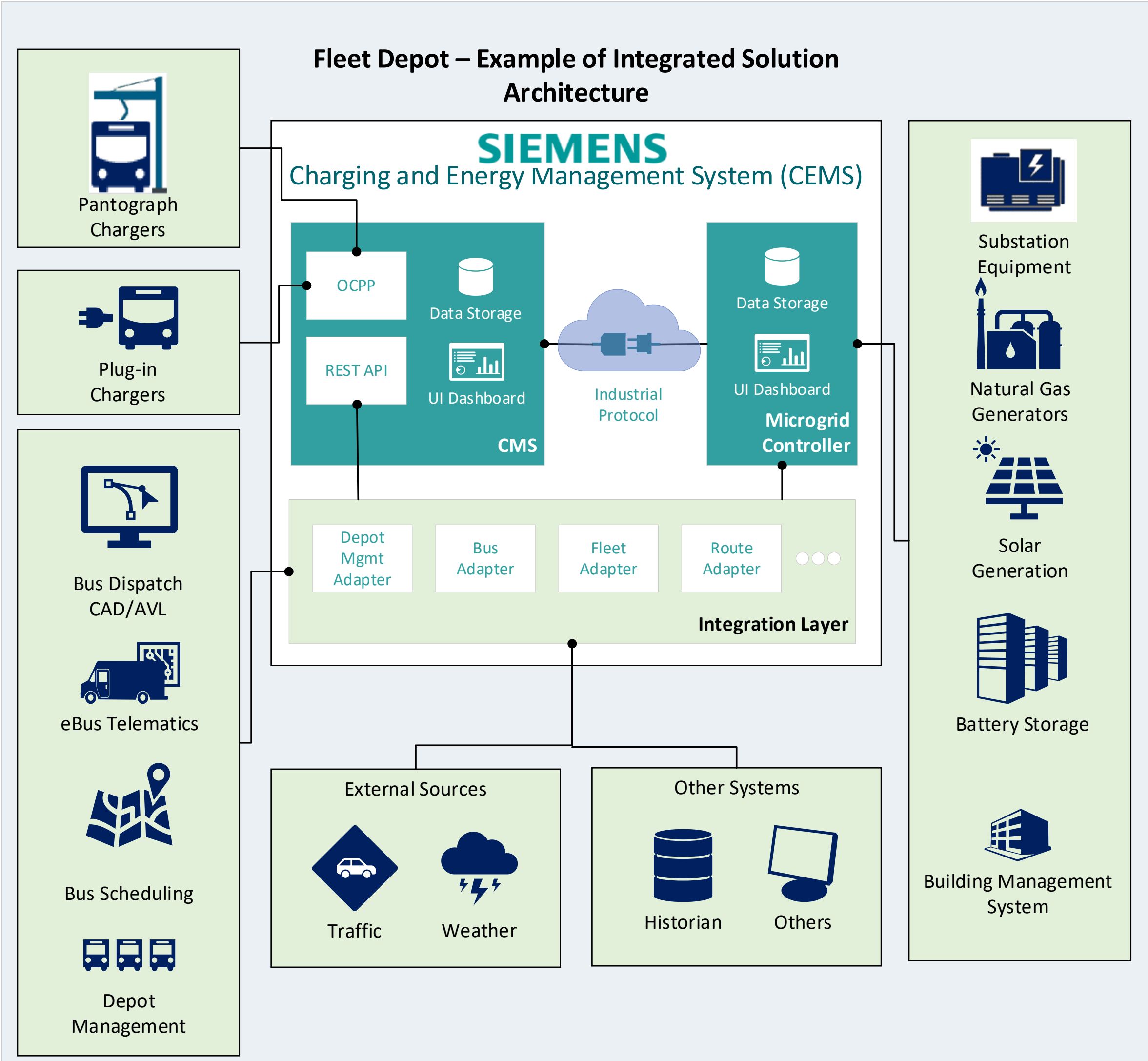

Figure 2 - Example of Integrated Software Solution

6 POTENTIAL IMPLEMENTATION PLAN

Summary

The following implementation plan is recommended for the electrification of the Brandon garage. As software was covered in the previous section, the below table is focused on hardware.

Hardware	Project Year of Initial Operation (assuming year 1 is 2023)	Comments
PV, BESS, and Microgrid Controller	Year 4	To mitigate grid supply deficit and provide outage resiliency

Transformer	2500 kVA: Year 1 5000 kVA: Year 6	2500 kVA supplied by Manitoba Hydro 5000 kVA, as part of Winnipeg Transit owned substation
Low Voltage Switchboards	Year 1	Future proofed installation
Charger Power Cabinets and CCS1 Dispensers	Incremental installation, in line with new BEBs.	1:1 ratio of BEBs to power cabinets may reduce charging complexity, in initial years. However, may affect ability to manage load.

Details

With respect to an implementation plan, there are a few critical assumptions to consider. The first and most important of those assumptions is Winnipeg Transit's BEB procurement schedule, which is 15 BEBs per year until 2027 and 30 BEBs per year afterwards. The Siemens team has considered that the first BEBs will be introduced in 2023 and the Brandon Garage will be a fully electric bus depot by 2028. Per the modelling completed, we anticipate that 2026 will be the first year where the currently available grid supply will not be sufficient to support all electrical loads at the Brandon Garage. In order to avoid having to delay the BEB procurement schedule or engage the use of the diesel generator on a frequent basis, the Siemens team recommends that the BESS, PV, and microgrid controller installation be completed by the end of 2025, at the latest. These systems will support Winnipeg Transit with overcoming the grid power supply deficit in 2026 and 2027, prior to Manitoba Hydro's planned grid upgrade, while providing outage resiliency in the following years.

With respect to the transformer, it is recommended that Manitoba Hydro immediately upgrade the existing 750 kVA transformer to 2500 kVA. This transformer would then supply all grid power to the site from 2023 until the end of 2027. At that time and following the completion of Manitoba Hydro's grid upgrade, Winnipeg Transit will need to install its own substation, complete with its own 5000 kVA transformer. This would then be the recommended end state, with respect to the grid connection at the Brandon Garage.

In terms of the outdoor and indoor low voltage switchboards, Siemens recommends that the switchboards for the end state be immediately installed, per the SLD provided. These switchboards will of course be underutilized at first, but it will be much easier to take this approach, rather than making incremental upgrades every couple years.

Finally, the Siemens team recommends that Winnipeg Transit consider installing the charger power cabinets in a 1:1 ratio with the BEBs at first, as this will eliminate the complexities of sequential charging at the onset of the project and allow Winnipeg Transit to focus on transitioning to this new technology, from an operational perspective. Based on the capabilities of the currently existing technology, additional remote dispensers can be connected to each charger afterwards, in a ratio of up to 1:4. The only aspect of this approach that will need to be further reviewed is the load management implications of an initial 1:1 ratio of BEBs to power cabinets. The potential building expansion concept and the timeline associated with it is discussed further in the Preliminary Cable Schedule report, where an installation year of 2025 is considered.

In terms of software, it is recommended that Charge Management Software be implemented at the onset of the project, with the first chargers delivered. For management of the DERs, this software will be provided with the microgrid controller, when it is installed in the recommended year of 2025. With respect to the implementation of additional software for the management of battery electric buses, such as Depot Management Software, this will need to be a collaborative discussion with the Winnipeg Transit IT team. While the Siemens team foresees that this software, along with an RTLS system, will be a requirement to manage a fully battery electric bus garage, this will need to be analysed further in a follow-up consultation. At first glance, it is recommended that the Depot Management Software and RTLS be installed once the number of BEBs exceeds the 20% spare ratio of the Brandon Garage, which would occur around 2025 based on the anticipated procurement schedule.

7 APPENDIX

7.1 Summary of project risks

Per Winnipeg Transit's request, a summary of the top project risks is provided below:

1. The grid supply line upgrade by Manitoba Hydro is not completed by 2027. This would mean that even with the proposed DER solution being put in place, BEB procurements may need to be delayed or the DER asset mix may have to change.
2. The actual energy demand required for charging of 105 operational BEBs is higher than simulated. This may lead to a requirement for more chargers and larger MV & LV infrastructure. It may also mean that DER assets are required sooner in the project, to manage the higher load.
3. Parking management with BEBs. As fueling will take much longer with BEBs, management of the buses in the garage will become more challenging and integration of a Depot Management Software c/w RTLS will likely be required.
4. The roof structural reinforcement requirements for the PV system are not possible to complete. This would affect the final DER asset mix, as the rooftop solar is a key element of it.
5. Outages exceed the length of time anticipated in the simulation. This could lead to a situation where the DERs are not able to mitigate the outage and service delivery may be affected.

7.2 PSS®DE "Energy Twin" report

The file titled "Brandon Garage Electrification Plan – Energy Twin Report – 2022.03.04" is a key deliverable of the project and provides recommendations for the optimal Distributed Energy Resources to install at this site, in order to support Winnipeg Transit's electrification goals.

7.3 Charging load profiles & energy calculations

Several files comprising the raw data from the Siemens load profile simulations are included in the final set of deliverables. The aggregate charging load profiles, which have been calculated and graphed, are also provided.

7.4 Drawings

The following drawings were created by the Siemens team for this consultation, as listed below:

1. Winnipeg Transit - Brandon Garage - Power Distribution SLD - Rev1
2. Winnipeg Transit - Brandon Garage - Dispenser SLD - Rev1
3. Winnipeg Transit - Brandon Garage - Power Cabinet Layout - Rev4
4. Winnipeg Transit - Brandon Garage - Power Cabinet Side View - Rev1
5. Winnipeg Transit - Brandon Garage - Dispenser Layout - Rev0
6. Winnipeg Transit - Brandon Garage - Dispenser Side View - Rev0
7. Winnipeg Transit - Brandon Garage - Building Expansion Top View - Rev0
8. Winnipeg Transit - Brandon Garage - Building Expansion Side View - Rev0
9. Winnipeg Transit - Brandon Garage - Dispenser 3D Model – Front
10. Winnipeg Transit - Brandon Garage - Dispenser 3D Model – Isometric
11. Winnipeg Transit - Brandon Garage - Dispenser 3D Model – Side

7.5 Preliminary cable schedule

A preliminary cable schedule, which compared the pros and cons of two potential locations for the 150 kW power cabinets, was requested by Winnipeg Transit. This information was provided in a separate 4-page write-up, titled “Brandon Garage Electrification Plan – Preliminary Cable Schedule”. The concept of a building expansion was also discussed further in this file.

7.6 Q&A file

A detailed Question & Answer file was collaboratively completed with Winnipeg Transit and comprises 100 separate line items. The information in this file was invaluable in the completion of this report and is attached to the final set of deliverables, for future reference.

7.7 Winnipeg Transit bus schedule

Winnipeg Transit provided a simulated battery electric bus schedule for the Brandon Garage, which was the critical input used by the Siemens load profile simulation team. This schedule reflected both Summer and Winter scenarios, as well as midday charging for many of the buses.

7.8 Winnipeg Transit bus specifications for energy evaluation

Another important input provided by Winnipeg Transit was a file containing the worst-case energy demands of the 40-foot, 60-foot, and 60-foot BRT buses which are planned to be electrified. These energy demands were provided for both Summer and Winter scenarios, allowing the Siemens load profile team to accurately calculate the BEB battery SOCs.