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1.0 INTRODUCTION

The City of Winnipeg has initiated a program to perform upgrades to the wastewater treatment systems at the NEWPCC, SEWPCC, and WEWPCC facilities (Winnipeg Sewage Treatment Program – WSTP). This technical memorandum is presented specific to the electrical distribution upgrade planned for the NEWPCC facility with respect to the electrical tie-ins that will arise due to the changes proposed for the facility (referred to as Tie-in #7b). A high level overview of the electrical upgrades including expected scope of work, constructability, schedule, constraints and risks related to the tie-ins as presented by the City of Winnipeg/Veolia NEWPCC Process Selection Report, Phase 2 Rev. 0 is outlined. A Class 5 cost estimate for the proposed tie-ins is presented in Section 3.0. The estimate does not include the overall electrical construction cost for the proposed expansion work but rather only the additional costs necessary to facilitate the installation due to specific requirements for phasing of the installation and associated risk mitigation.

1.1 Definitions

BNR	Biological Nutrient Removal
CSA	Canadian Standards Association
DCS	Distributed Control System
DSC	Distribution Supply Centre
E&I	Electrical and Instrumentation
HVAC	Heating Ventilation and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
NEWPCC	North End Water Pollution Control Centre
NFPA	National Fire Protection Association
PSR	Process Selection Report
SCCR	Short Circuit Current Rating
UV	Ultra violet
VFD	Variable Frequency Drive
WSTP	Winnipeg Sewage Treatment Program

2.0 SCOPE OF WORK

The conceptual planning information described in Revision 0 of the Veolia Phase 2 PSR provides the basis for the expected changes contemplated at the NEWPCC. The extent of changes proposed will require the complete replacement / upgrade of the existing electrical power supply at the NEWPCC due to the expected load growth and the new facilities to be added.

This technical memorandum will review the means available to establish a new power supply that replaces the existing main electrical supply to the plant. It will describe the phasing necessary to achieve the replacement / upgrade, describe any potential risks associated with the replacement / upgrade, provide an opinion of costs and a proposed schedule to complete the replacement / upgrade. The estimated costs would be only those costs arising from the phased approach that would be additional to the normal capital costs.

The overall objective for this undertaking is to provide a technical review of the conceptual planning associated with the NEWPCC master plan development. The review provided herein is based on the professional opinion of SNC-Lavalin Inc. (SLI) regarding “proof of concept” for tie-ins between existing and new facilities. However, it is recognized and expected that the actual implementation of the work described herein, when it occurs, will be subject to change. The intent of this investigation is to establish the feasibility of the concept and identify potential issues and not the development of a specific design or construction plan.

2.1 Power Supply Requirements

2.1.1 Existing Electrical Power Supply

The existing power to the NEWPCC is provided by Manitoba Hydro via two 66 kV wood pole transmission lines sourced from two independent substations on Manitoba Hydro’s system. The original supply configuration consisted of a Manitoba Hydro owned switchyard with two 66 kV / 4160V, 7.5 MVA oil filled transformers. The transformers and switchyard are approximately 50 years old. The secondary connection consists of 2 cable potheads providing the transition from the above ground transformer secondary terminals to the underground cables feeding a line-up of 4160 volt metal enclosed switchgear in the main electrical room of the Grit Building adjacent to the switchyard.

The switchgear is arranged with two main incoming circuit breakers and a bus tie to facilitate connection to the other supply line in the event of a single line outage. Each switchgear assembly associated with each main breaker provides feeders to the various principal areas of the plant and the split bus architecture incorporates a level of redundancy via the tie breaker and dual feeder arrangement. Manitoba Hydro owned secondary revenue metering is incorporated into the 4160 volt switchgear line-up. The total load on the plant in the past was typically within the rating of one of the 66 kV, 7.5 MVA transformers.

The recent addition of the UV disinfection facility necessitated the addition of a third transformation, due to the added load which exceeded the existing transformer ratings. This addition occurred in 2005 and required the installation of a single distribution supply centre (DSC) transformation rated at 66 kV / 4160V, 5 MVA. The connection on the 66 kV incoming line was performed via a tie-tap arrangement on the overhead Fernbank R-84 main line with associated primary fused disconnect. In accordance with Manitoba Hydro standard policy, the new installation was equipped with primary metering. The secondary switchgear was integrated into the existing 4160 volt line-up and included a tie breaker scheme to replicate the split bus arrangement utilized throughout the existing plant.

Refer to sketch SK01 in Appendix A for a single line diagram representing the existing distribution.

The original design for the UV facility expected that all UV power would be fed via the new 5.0 MVA transformer PDT-1 and its associated 4160 volt breaker 52-U1. Through operating experience it was found that this scheme would necessitate total UV plant shutdown and resultant short term effluent treatment interruptions when the power supply was switched to Bus #2 (via 52-F7). To avoid this shortcoming, UV power supply has been recently modified to continuously provide power via breakers 52-F7 and 52-U1 (tie breaker 52-TU1 is always open except when one of the UV feeders is lost or shutdown).

Therefore, UV power is provided via Bank 2 and Bank PDT-1. This operating configuration will affect phasing considerations to be discussed in subsequent sections of this memo.

The existing electrical loading at the facility based on Manitoba Hydro records for the period of January 2007 to March 2013 shows a total maximum plant load of 11.01 MVA in July 2010. A detailed listing of monthly electrical loadings during the above period is included in Appendix B. It should be noted that the maximum plant load value is based on the summation of 3 separate meters and that the maximum reading from these individual meters may not be coincident. Therefore, the maximum value experienced may not be exactly as noted but it is likely that the values shown on the listing are close enough to the maximum value to indicate that it is reasonably representative.

Bulk power distribution throughout the existing plant is performed at 4160 volts. The main building pumping facility utilizes 4160 volts directly to power the large raw sewage pumps. The balance of the loads throughout the plant are powered at 600 volts, or at 120 / 208 / 240 volts. Transformations are provided at the main drop points (Main Building, Dewatering, Secondaries, Digesters, Reactors, UV Disinfection) throughout the plant to convert from 4160 volts to the desired utilization voltage.

2.1.2 New Power Supply Requirements

Based on information received from Veolia / City, the estimated power requirements for the expansions contemplated at the NEWPCC are detailed in Table 1 below.

NEWPCC Process Facility	Estimated Electrical Load (kw)
Raw Water Pumping	4,801
Pre-Treatment	272
Primary Treatment	1,230
Activated Sludge (includes Intermediate Pumping Plant)	8,404
UV Disinfection	1,762
Wet Weather Flow Treatment	470
Odour Treatment	2,074
Bio Solids Treatment	2,400
Centrate Nitrogen Removal	1,000
Utilities	40
Auxiliaries	385
TOTAL	**22,832**

Table 1: Estimate of Plant Loads After Upgrade

The new power requirements exceed present power supply capacity and therefore a completely new arrangement is needed to satisfy the projected power needs.

In addition, the growth in power requirements will necessitate a review of the plant utilization voltage. Distribution of power around the plant should be performed efficiently to avoid excessive power losses and voltage drop. Large power utilization at lower voltage levels will result in the presence of higher load currents which will affect power losses and voltage drop. Typical standard utilization voltages in use include 4160 volts, 12,470 volts, 25,000 volts and 35,000 volts. Based on the increased load requirements identified, a utilization voltage increase from 4.16 kV to at least 12.47 kV is recommended for the NEWPCC.

It is understood that the plant upgrade will occur using a transitional approach to allow continued operation and that portions of the plant will be retained for the long term (eg. UV disinfection). Consequently, the existing 4160 volt distribution will need to be retained to facilitate the transition and possibly beyond (to some extent) depending on the ultimate plant configuration. Some or all of the existing loads may be converted to the higher distribution voltage as part of future detailed design implementations. Therefore, the new power supply must make provision to feed the existing distribution as well as provide supply feeders to new loads for bulk power transfer throughout the plant at the recommended higher voltage.

The existing plant distribution design incorporates a split bus, dual feed arrangement with an open tie breaker for reliability of supply in the event of the loss of a single feeder. This arrangement is implemented throughout the existing plant and therefore the replacement supply will employ the same approach to redundancy.

The new load requirements will necessitate the installation of an upgraded electrical installation to supply a new 12.47 kV distribution as well as the existing 4.16 kV distribution. To ensure that sufficient spare capacity exists, the new transformation would have to be sized for the load noted plus approximately 25% which would suggest a transformer rating of approximately 28.5 MVA. The size noted should be subject to further review and confirmation during the design phases of the project.

This transformer rating would suggest a traditional oil filled transformer with air insulated primary and secondary terminations within a standard substation support structure arrangement similar to the current installation.

While the traditional approach could be considered, several constraints exist including space considerations, access to the existing 66 kV supply lines and the need to maintain plant operations during the entire transition / tie-in process.

Under these circumstances, a non-traditional approach may be needed. A traditional substation arrangement could be adopted however, this would have to be established at a different location on the plant site to facilitate continued plant operations while the new supply is constructed. Further discussion of this potential tie-in option will be provided in the following section.

Implementation of an upgraded supply on the existing power supply location would need to accommodate the space constraints that exist as well as incorporate a specific phased approach to implementation that will allow continued plant operation while the new installation is constructed.

Present space restrictions would suggest that a design approach similar to that used for the UV disinfection power supply implementation in 2005. This involved the use of a distribution supply centre concept (DSC). The advantages of this approach include:

- Eliminates the need for station structures and a fenced switchyard.
- Reduced space requirements.
- More expedient implementation in a reduced timeframe.

Considerations associated with this concept include:

- Maximum transformer size is limited to 20 MVA.
- The surrounding area including the transformer dead front enclosure must be suitably grounded to satisfy IEEE 80 requirements.

- Allowance must be made for the installation of pole mounted switches, primary fuses, lightning arresters, cable terminations and primary metering equipment.

Based on the configuration of the existing plant electrical supply substation, the DSC approach offers a flexible implementation to achieve the desired modified installation at the present power supply location under the current constraints. Accordingly, the tie-in implementation at the existing power supply location will utilize the DSC concept to achieve a phased transition from the existing supply configuration to the new configuration to satisfy the expanded power needs. If an alternative location were to be considered for the new plant power supply, it is expected that the implementation would be based on a traditional open substation with dual transformers much like the current installation.

3.0 TIE-IN CONFIGURATION

Based on the foregoing, two potential options for redevelopment of the electrical tie-ins were considered as follows:

Option 1 Utilize the existing substation footprint, tie-in with the existing Manitoba Hydro overhead high voltage feeders utilizing the DSC concept and supply the existing 4160 volt distribution through a transitional approach. All other plant loads would be supplied via a new 12.47 kV distribution located adjacent to the DSC equipment.

Option 2 Select a new site for a new substation at another location on the NEWPCC property, re-route the existing Manitoba Hydro overhead 66 kV lines to suit, establish a traditional dual transformer open substation installation complete with new secondary 12.47 kV switchgear and feed the existing 4160 volt distribution from the new 12.47 kV distribution.

Under Option 1 there would be minimal changes to the 66 kV overhead Manitoba Hydro lines, and the connection to the existing 4160 volt distribution could be achieved with a transitional installation of new 12.47 kV to 4160 volt transformations.

Considerations associated with this option would include the following:

- Because the total plant load, with allowance for spare capacity, would be in the neighbourhood of 29 MVA, a total of 3 transformers would be required to achieve full redundancy.
- Although modifications to the off-property 66 kV supply lines from Manitoba Hydro would be minimal and for the most part could be utilized as is, the existing overhead lines that enter the City of Winnipeg property at the Grit Building will need to be completely modified to accommodate the new arrangement. Connections to the existing 66 kV line would need to be coordinated with Manitoba Hydro to ensure proper positioning of the 66 kV sectionalizing switches (existing and any new additions).
- The existing UV facility, 5 MVA DSC transformation will need to be removed to allow for the line modifications and DSC transformation additions. The existing 4160 volt switchgear, including the UV switchgear, would be re-used during the transition and beyond to the extent needed to satisfy long term site planning.
- The existing substation site would be modified to accommodate the new 12.47 kV distribution. This would maintain all incoming electrical supplies to the plant at the same location.
- Connection to the existing 4160 volt distribution would be reasonably straightforward and achievable at reasonable cost due to its close proximity to the proposed new distribution.
- The DSC concept, although somewhat complex from a phased installation perspective, is very space efficient and avoids the need to establish a new power supply point for the site which would entail consideration of a host of issues including (but not limited to) space allocation, grounding requirements, site set-up, modifications to existing 66 kV supply lines, permitting and approvals including environmental, potential time delays, etc.
- Since Manitoba Hydro owns the present substation, they will be involved in the salvage of the existing facilities. This will present a cost issue and a potential timing constraint that must be incorporated in the phasing plans.
- The existing substation would have to be reviewed by Manitoba Hydro to ascertain existing grounding conditions and to identify additions if any and environmental issues with required remediation (previous occurrences of transformer oil spills / leaks).
- The electrical upgrade will concentrate all of the supply infrastructure in one location which will make the installation vulnerable to a significant catastrophic event. This would affect supply reliability however the likelihood is considered to be extremely low as evidenced by the service record of the existing installation

which has operated for nearly 50 years without a major incident. In addition, physical diversification to overcome this disadvantage would require a significantly different design approach that would require further investigation to establish feasibility and is beyond the scope of this investigation.

- This option has not considered the provision of standby generation as an integrated part of the main incoming supply. If standby generation is required (typically for raw sewage pumping, BNR plant and miscellaneous plant utilities such as HVAC), it is assumed that this would be accomplished using a distributed system approach rather than a centralized installation. It is further noted that the existing location of the incoming supply is constrained from a space perspective and further review would be necessary if centralized standby generation was to be considered (select an appropriate location, possibly to the north of the existing Grit Building and design an essential 12.47 kV Bus).
- Preliminary review of the existing site footprint has confirmed that sufficient space exists to accommodate three DSC transformers with primary metering, isolation devices and protection equipment, a new 12.47 kV switchgear building, two voltage reduction transformers to supply the existing 4160 volt switchgear and a third 12.47 kV / 4160 volt transformer for the UV supply.
- Ownership of all high voltage equipment including transformations (66 kV / 12.47 kV) would need to be reviewed and confirmed with Manitoba Hydro prior to the start of design. In addition, system operating agreements would also need to be negotiated.
- During the transitional phases of the work, there will be periods where the plant is supplied from only one transformer bank. The phasing proposed herein will be developed to minimize these durations and additional measures will be put in place to provide some level of contingent backup where single bank operation is unavoidable. It should be noted that the contingencies proposed did not include standby generation as the provision of sufficient capacity would be quite difficult and costly to execute with any measure of success. This however does not preclude the use of spot standby generation to support specific load areas within the plant if so desired. The concept proposed herein with the included backup contingency measures is considered to be a reasonable approach based on the low probabilities of failure. Should such an event occur, short term power loss would be inevitable (approximately 24 hours) and spot standby generation may be considered however, these costs have not been included at this time.

Option 2 would involve the establishment of a completely new power supply facility at a different location on the plant site. This approach would allow the construction of a new facility while the existing supply substation operation is maintained, thus avoiding a phased construction process for the most part.

Considerations associated with this option would include the following:

- The new site selection should ideally be positioned along the north property line of the NEWPCC to facilitate access to the existing 66 kV overhead supply lines from Manitoba Hydro. Availability of such locations, based on the present Veolia Phase 2 PSR, appear to be limited (potentially one site exists to the east of the existing Grit Building) and can only be accommodated with the re-arrangement of the proposed plant process layout.
- Any of these new sites will require the reconfiguration, re-routing and / or extension of the existing 66 kV overhead supply lines from Manitoba Hydro. This would potentially entail significant coordination with Manitoba Hydro, significant time to achieve the required permitting, the need for right of way acquisitions and environmental reviews (if required) and significant extra cost for the City.
- If a site adjacent to the north property line is not available, a location within the property would necessitate the extension of overhead 66 kV lines into the plant property which would not be desirable from an operational perspective and may not be provided by Manitoba Hydro (in any event).
- A new power supply site could be configured using a traditional substation arrangement. Standby generation, if required, could also be incorporated using a centralized arrangement.

- The addition of two voltage reduction transformers at the existing substation would still be required to supply the existing 4160 volt switchgear.
- Since Manitoba Hydro owns the present substation, they would be involved in the demolition / salvage and site remediation work (all at City expense). This would however, not be on the critical path since this work would be executed after the new supply has been energized and the existing has been de-energized.

While it is acknowledged that implementation using the Option 2 approach could prove to be feasible, significant concerns with respect to coordination with Manitoba Hydro and associated timing could make this option unworkable. Further specific investigation with input from Manitoba Hydro would be needed to confirm the feasibility of this option. However, such investigation is beyond the scope of this review. Since Option 1 presents a feasible alternative for new power supply tie-in, this option has been selected for further implementation review to establish the necessary tie-in requirements. Option 2 has not been included in any further reviews in the technical memo. It is noted that the City may still decide to investigate the feasibility of Option 2 to confirm its viability.

Utilizing the Option 1 concept, the proposed power supply configuration is described on the single line diagram included as SK02 of Appendix A.

The existing substation was configured with a redundant set of 7.5 MVA transformers. The historic loading for the plant is shown in Appendix B.

The maximum historic loading on the 4160 volt Bus #2 is approximately 3.9 MVA. The loading on Bus #1 is approximately 7.9 MVA and this value includes the UV service load which is manually consolidated with the Bus #1 meter reading by Manitoba Hydro. The present UV loading is estimated to be approximately 2 MVA (much less under low flow or nominal conditions) resulting in a peak Bus #1 loading of approximately 5.9 MVA.

As noted previously, the load readings are summations from several meters that may not be experiencing their maximum reading at a coincident point in time. Also, the peak loading at the plant is predominantly driven by the Main Building raw sewage pumps. This implies that individual bus loading is highly dependent on pump selection and requirement. While there appears to be a wide difference in maximum loading between Bus #1 and Bus #2, it is expected that the loadings are likely somewhat lower than the values indicated and that a more even load distribution is possible with modified operating strategies.

Therefore, it is felt reasonable to assume for this concept development that a maximum capacity for each existing 4160 volt bus would be adequately addressed with a 5 MVA rated supply (if you exclude the UV facility). It is also expected that, as the upgrade of the NEWPCC progresses, after the new 12.47 kV distribution is in place, the loading on the existing 4160 volt system will gradually diminish. This rating for the 4160 volt system should be subject to further review and confirmation during the design phase of the project.

Since the UV facility is to be retained as part of the long term plant configuration, a more permanent arrangement for these feeders should be considered. Accordingly, it is proposed that a new 2.5 MVA transformation from 12.47 kV to 4160 volts should be added as a dedicated feed to this facility during the transition. The transformer would, under this concept, be located in the existing substation yard adjacent to the 5 MVA units. If the existing 4160 volt distribution is decommissioned after the completion of the NEWPCC upgrades, the 2.5 MVA transformer could remain to supply the UV facility and a second unit could be added for redundancy via the existing switchgear in the Grit Building.

Alternatively, the UV transformations could be located adjacent to the UV facility. This would require the installation of 12.47 kV feeders to the UV plant and the elimination of the existing UV switchgear in the Grit Building (secondary protection would be located at the UV building).

These details, as well as confirmation of the transformer sizings noted herein, would be subject to further review during detailed design and such reviews can occur without any material impact to the tie-in concept proposed here.

After completion and establishment of the new 12.47 kV distribution at the existing substation location, all other subsequent power supply tie-ins would involve the supply of new main feeders back to the respective 12.47 kV main distribution breakers. These tie-ins would be considered to be part of the normal detailed design provisions for each new part of the plant as it is added.

Due to the fact that the power supply modifications contemplated for the NEWPCC are a major change from the current installation, a significant level of engineering will be necessary to confirm all details and the overall feasibility of the concept. In addition, consultation with Manitoba Hydro will need to occur at an early stage to ensure that the new supply configuration is fully aligned with their system supply configuration and any constraints that may exist within the Hydro system. Therefore, it is very important that the engineering process of concept confirmation and Manitoba Hydro consultation occur at the earliest possible opportunity to avoid unexpected delays in the desired in-service date for the new power supply at the NEWPCC.

4.0 IMPLEMENTATION AND PHASING

As noted previously, the new power supply tie-in concept is proposed to make use of the existing 66 kV / 4160 volt line entry and substation site. Since the plant must continue to operate during the entire transition process with the least amount of interruption, a staged approach to implementation must be utilized.

It is expected that the work would be performed in five (5) stages to facilitate the installation of each of the three (3) main transformer banks. The outline of the work phasing is provided below with accompanying diagrammatic layouts of the work as shown in Figures 1, 2, 3, 4 and 5 and the associated drawings SK03, SK04, SK05, SK06 and SK07 of Appendix A.

Stage 1 Work:

a) Perform necessary site preparation work in the area adjacent to the northwest corner of the existing substation. Provide necessary grading, base preparation and provisions for electrical grounding.

b) Construct new pad for the new Bank 1 20 MVA transformer, and install transformer to the northwest of the existing Bank 1 transformer outside the existing substation fence as indicated on Figure 1 and SK03.

c) Construct the new 66 kV overhead line for the new Bank 1 transformer complete with a dead end structure, pole top disconnects, metering facilities pole top circuit switcher, right angle transition with disconnect, lightning arresters, and primary cable dip pole to connect the new Bank 1 transformer. The right angle transition with disconnect is provided to facilitate a connection to the primary of the future Bank 2 and would only be needed in the event of a failure of the Bank 1 transformer.

d) Construct a new temporary pad for four (4) 12.47 kV outdoor load break disconnect cells. The cells will provide temporary primary and feeder disconnects to the new 12.47 / 4.16 kV transformers.

e) Run temporary 15 kV cables from the new Bank 1, 20 MVA transformer to the temporary main disconnect switchgear.

f) Construct three (3) new permanent pads for the 12.47 / 4.16 kV, 5 MVA transformers (Bank 1A and 2A) and 12.47 / 4.16 kV, 2.5 MVA transformer (Bank 3A).

g) Run temporary 15 kV cables from the new feeder disconnect switchgear to the 5 MVA and 2.5 MVA transformers.

h) Locate and install permanent 5 kV cable from each transformer to the existing switchgear in the Grit Building. Connection to the existing 4160 volt switchgear would occur at a later stage.

i) Transfer existing 5 kV Main Bus #1 load to Bus 2 by opening breaker 52-L1 and closing tie breaker 52-T.

j) De-energize the 66 kV line feeding the existing Bank 1 transformer and permanently disconnect Bank 1.

k) Remove / modify existing Bank 1 66 kV lines and hardware.

l) Construct new 66 kV overhead transition from the old 66 kV Bank 1 line to the new 66 kV dead end structure.

m) Perform testing and commissioning of equipment related to the new Bank 1 equipment.

n) Energize the new Bank 1 66 kV connection including the new transformer and secondary 12.47 kV temporary switchgear.

o) When all 66 kV Bank 1 equipment is operational, open the existing 4160 V 52-T tie breaker. Permanently connect the new 5 kV cable from the new Bank 1A 5MVA transformer to supply breaker 52-L1. This work should be done during the low load night hours.

p) Energize 5 MVA transformer Bank 1A and close breaker 52-L1.

This now has one side of the existing 5 kV distribution on the new Bank 1 and Bank 1A and the other side on the old Bank 2. All stage 1 work is now complete. Refer to Figure 1 and SK03.

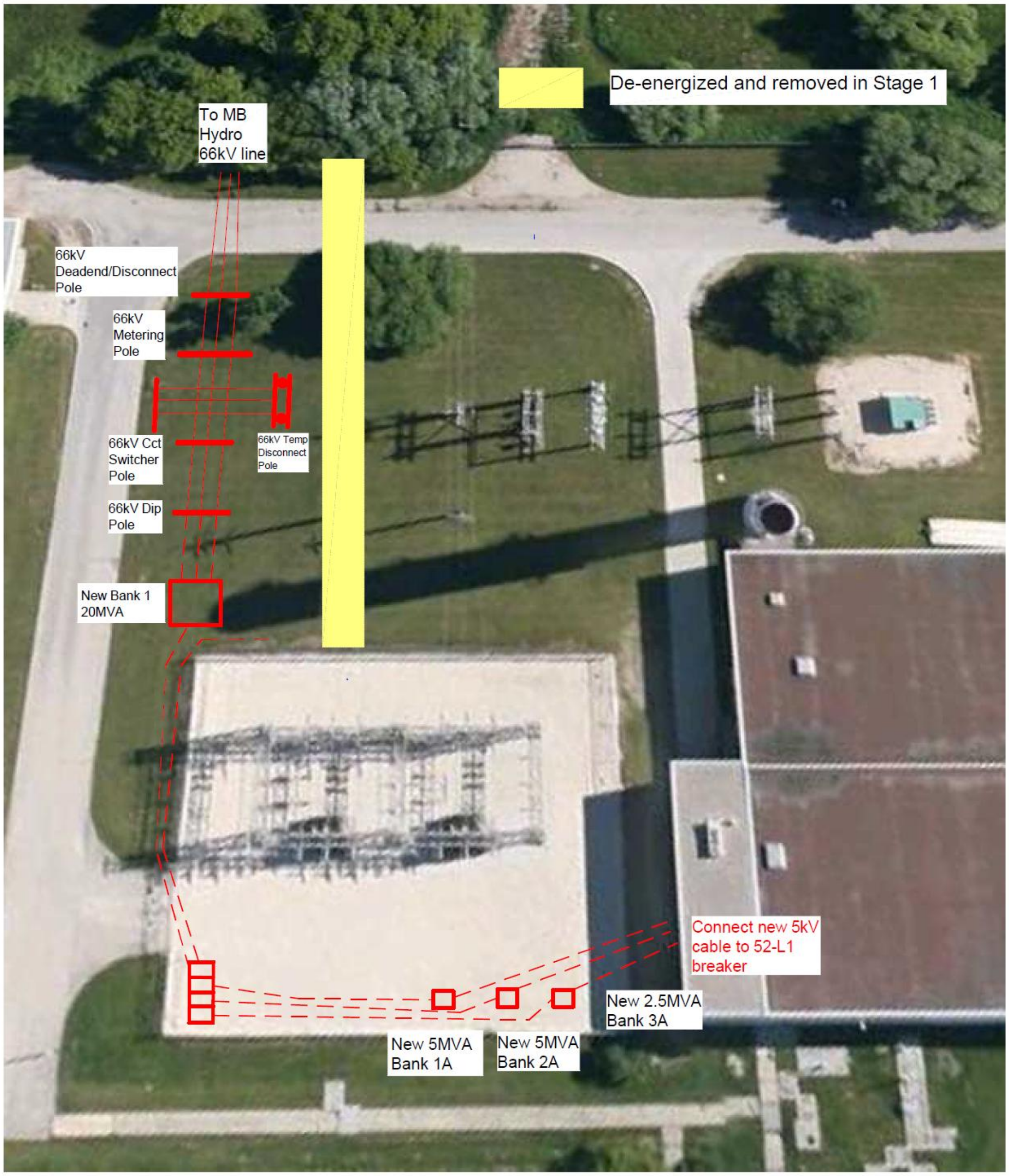


Figure 1: Stage 1 Work

Stage 2 Work:

a) Open breaker 52-U1. Close UV tie breaker 52-TU1. De-energize existing UV transformer PDT-1 via the 66 kV primary disconnects. Disconnect existing 5 kV cable to 52-U1 and install new permanent 5 kV cable from the new 2.5 MVA transformer that was provided under Stage 1. Open breaker 52-TU1. Energize new UV transformer via its respective temporary 15 kV switchgear. Close breaker 52-U1. Bus 1 of the 5 kV distribution and a portion of the UV facility is now powered by the new Bank 1 transformer. Bus 2 of the 5 kV distribution continues to be powered from the existing Bank 2 transformer and will power the remaining UV loads via breaker 52-F7. The existing 5 MVA UV transformer is now de-energized.

b) Open breaker 52-L2. De-energize the existing Bank 2 transformer primary. Disconnect existing 5 kV cable and install new permanent 5 kV cable from Bank 2A to the existing 52-L2 switchgear that was provided under Stage 1. Then, close the 52-L2 breaker. Both 5 kV Main Bus No. 1 and 2 and the UV facility are fed from the new Bank 1 transformer. This work should be done during the low load night period. Refer to Figure 2 and SK04.

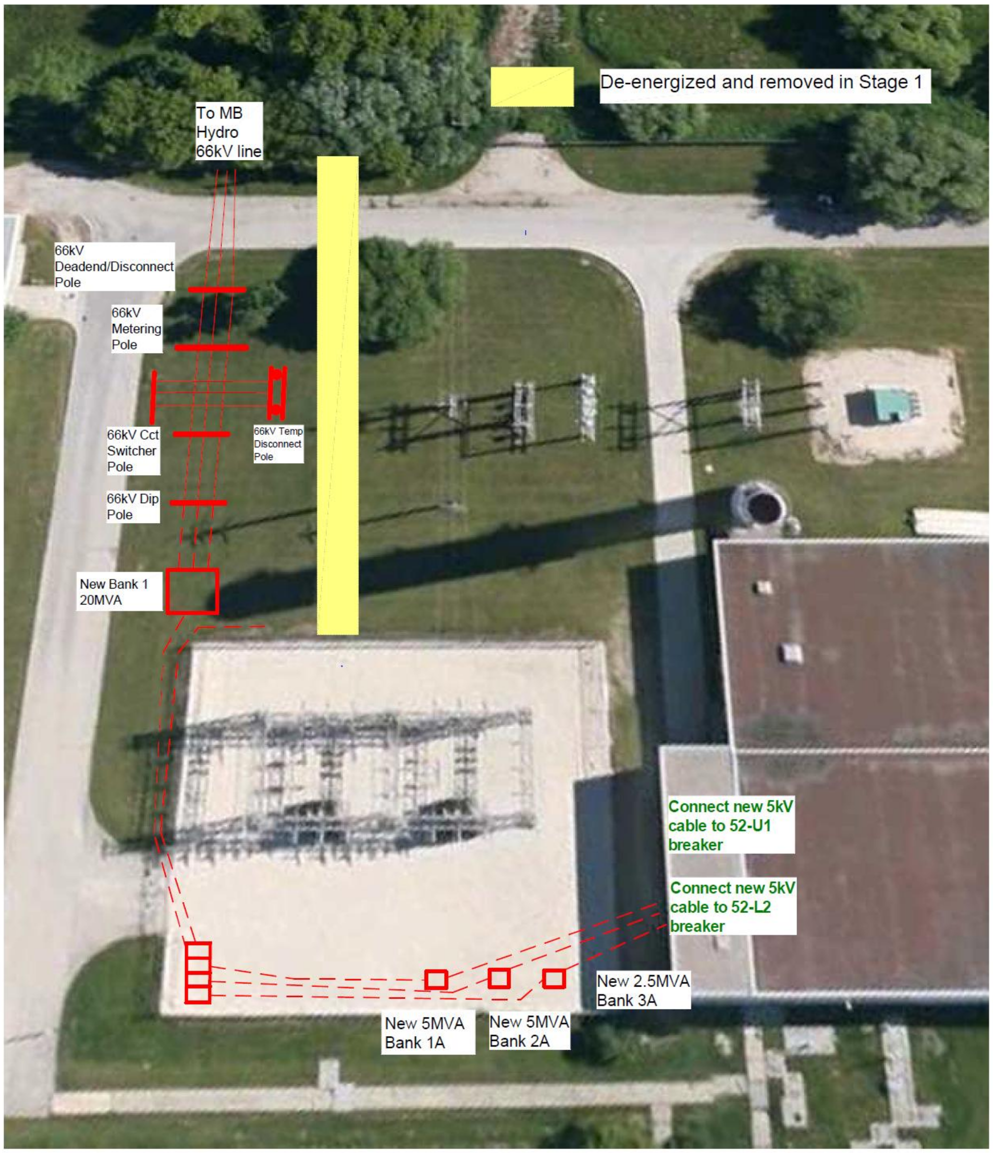


Figure 2: Stage 2 Work

Stage 3 Work

a) De-energize and disconnect the 66 kV line feeding the Bank 2 transformer and the UV transformer.

b) Remove existing 66 kV lines in front of the existing Bank 2 transformer.

c) Perform necessary site preparation work to the North of the switchyard in front of the existing Bank 1 and Bank 2 transformers. Provide necessary grading, base preparation and provisions for electrical grounding.

d) Construct new pad for the new Bank 2 transformer and install the transformer as indicated in Figure 3 and SK05.

e) Construct new overhead 66 kV dead end pole and primary cabling, circuit switcher and disconnect and right angle transition pole assembly. This last assembly is to be installed as a contingency in the event of a Bank 1 failure to allow the quick connection of the Bank 2 primary. Complete the lateral 66 kV overhead connection from the right angle transition pole to the load side of the disconnect provided in step c) of Stage 1. Install the lateral connections for the Bank 2 primary such that the Bank 2 primary can now be energized via the Bank 1 66 kV line through the closure of the overhead lateral disconnect after the circuit switcher disconnect for Bank 1 has been opened.

f) Supply and install a temporary 15 kV cable from the 20 MVA, Bank 2 secondary to the temporary main disconnect switchgear associated with Bank 1. Do not connect either end of this cable however, make secure and weather resistant to be ready for use should a failure situation develop in the Bank 1 transformer circuit.

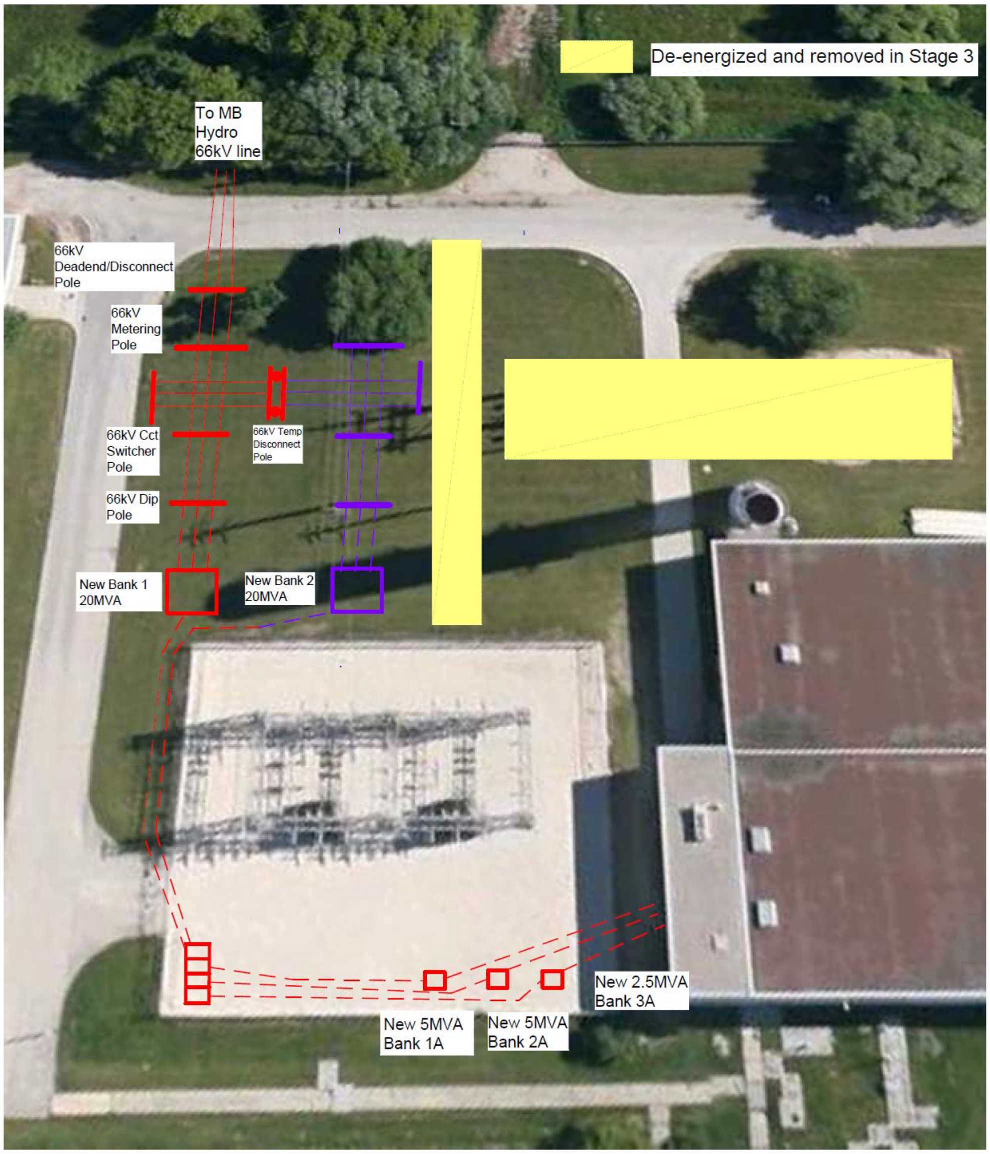


Figure 3: Stage 3 Work

Stage 4 Work

a) Complete 66 kV line removals associated with the existing Bank 2 and UV transformer connections out to the City north property line.

b) Remove existing 5 MVA DSC transformer and associated buried 5 kV feeder for the existing UV power supply.

c) Remove existing 7.5 MVA Bank 1 and 2 transformers and all associated substation lattice structure, apparatus, underground cable and any associated equipment. Since the existing substation is owned by Manitoba Hydro this part of the work must be done by Manitoba Hydro. Although the expected duration for the demolition and salvage is not expected to be long (approximately 1 month at most) and sufficient schedule allowance exists to accommodate this work. This portion of the work should be coordinated with Manitoba Hydro well in advance. A written agreement for the work to be performed by Manitoba Hydro together with specific dates for execution should be obtained well in advance to avoid timing and availability issues.

d) Perform necessary site preparation work to the northeast end of switchyard in the area in front of the existing Bank 2 transformer. Provide necessary grading, base preparation and provisions for electrical grounding.

e) Construct new pad for the new Bank 3 transformer and install the transformer as indicated on Figure 4 and SK06.

f) Construct new overhead lines and associated equipment for Bank 2 and Bank 3. This includes the main dead end and disconnect and metering equipment on Bank 2 for tie-in to the equipment constructed under Stage 3. On Bank 3, the full complement of main dead end and disconnect, metering, circuit switcher, lightning arresters and primary cable dip pole will be required.

g) The alignment of the overhead connections for Bank 2 and Bank 3 must be coordinated with Manitoba Hydro to ensure that the physical connections on the 66 kV transmission lines occur in the correct location in relation to the line sectionalizing switches. This issue must be reviewed with Manitoba Hydro well in advance to ensure that any modifications and / or additions (if needed) to the 66 kV transmission lines can occur in a timely manner to facilitate power supply by the date scheduled herein.

h) Construct new foundation and locate a new electrical building for the 12.47 kV switchgear in the yard area of the salvaged lattice structure. The electrical building could be a built in-situ facility or a pre-fabricated building via the switchgear supplier. Construction should include a permanent network of underground duct banks to facilitate 12.47 kV cable entry for all of the future cable feeders to the various areas of the plant.

i) Install permanent 15 kV cables from Banks 2 and 3 to the new main 12.47 kV switchgear cells that are dedicated to Banks 2 and 3.

j) Perform testing and commissioning of equipment related to Banks 2 and 3 equipment.

k) Construct new 66 kV overhead line final connections to Manitoba Hydro's transmission line for Banks 2 and 3. Once the connections are complete, energize the overhead lines up to the respective bank circuit switcher disconnects. Bank 2 and Bank 3 equipment is now available pending completion of the Stage 5 work and shall remain de-energized until the appropriate step is reached.

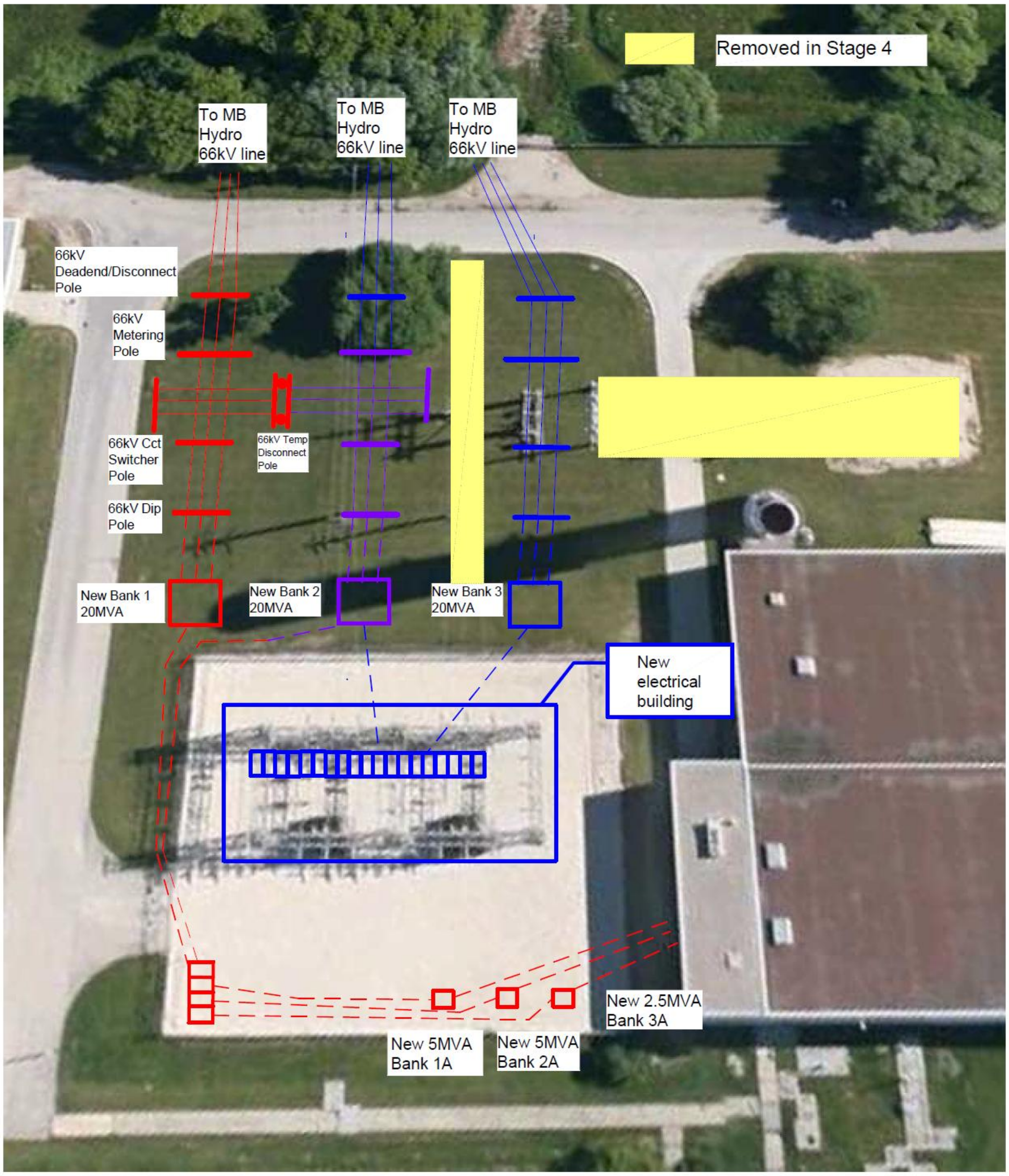


Figure 4: Stage 4 Work

Stage 5 Work

a) Install permanent 12.47 kV cables from the new switchgear to the new UV Bank 3A 2.5 MVA transformer primary (installed under Stage 1). Open 4160 volt breaker 52-U1 and close tie breaker 52-TU1 to maintain power to the UV facility. Open temporary 15 kV disconnect for the 3A primary. Remove the temporary 15 kV cable to Bank 3A and connect the permanent 15 kV cable. Once all cable connections are complete, the 15 kV UV feeder to Bank 3A can be energized. Energize 66 kV line feeding Bank 3A and close its associated 15 kV main breaker and the Bank 3A feeder breaker. The associated 4160 volt tie breaker 52-TU1 is opened and main breaker 52-U1 is closed to restore full UV power supply. This work should be scheduled during low flow periods to ensure that UV treatment efficacy is maintained to the greatest degree possible. The UV facility is now powered in part via the new Bank 3 equipment.

b) Install permanent 12.47 kV cables from the new switchgear to the new Bank 2A 5 MVA transformer primary. During the night in the low flow season, de-energize 4160 volt main breaker 52-L2 and close tie breaker 52-T. Open the temporary 15 kV Bank 2A feeder disconnect. Remove the temporary 15 kV cable connection between the temporary switchgear and the Bank 2A primary and connect the permanent 15 kV cable. Bank 2A can be re-energized via the new switchgear.

c) To facilitate subsequent work, energize Bank 2A via Bank 3 by closing the 15 kV tie breaker (CB-E705T) and feeder breaker CB-E720. Refer to sketch SK07. Open 4160 volt tie breaker 52-T and close Bus 2 main breaker 52-L2.Power for 4160 volt Bus 1 is via Bank 1 and Bank 1A, Bus 2 is via Bank 3 and Bank 2A and the UV is via Bank 3 and Bank 3A.

d) Isolate Bank 1 20 MVA transformer by opening the 4160 volt 52-L1 breaker and closure of the 52-T, 4160 volt tie breaker. Also open the 15 kV temporary gear main switch. Normal power to 4160 volt Main Bus #1 and #2 are now provided by the Bank 3 20 MVA transformer and the Bank 2A 5 MVA transformer. Since total existing plant load is limited to 5 MVA (excluding UV), this work should be done in the low load season.

e) Open Bank 1 66 kV disconnect. Install permanent 12.47 kV cables from the Bank 1 20 MVA transformer to the new 12.47 kV switchgear assembly. Remove the temporary 12.47 kV cable from the Bank 1 secondary to the temporary switchgear main.

f) Install permanent 12.47 kV cables from the new 12.47 kV switchgear to the Bank 1A 5 MVA transformer primary. Disconnect and remove the temporary connection from the temporary switchgear.

g) With 66 kV line feeds de-energized to Bank 1 and Bank 2, the backup 66 kV lateral assemblies installed under Stage 1 and Stage 3 can now be removed. Also remove and salvage the temporary 15 kV cable from Bank 2 to the temporary switchgear.

h) Once all 66 kV work is completed, re-energize the Bank 1 transformer. Close 15 kV main breaker CB-E704 and Bank 1A feeder CB-E710. On the 4160 volt distribution open tie 52-T and close breaker 52-L1.

i) Energize the Bank 2 transformer. Open 15 kV tie CB-E705T and close breaker CB-E705.

j) Once step i) is completed, the new 20 MVA Bank 1, 2, and 3 transformers and associated 15 kV switchgear will be fully operational. The existing 4160 volt distribution is powered via Bank 1A and 1B and the UV is powered via Bank 3A.

k) All temporary cables shall have been disconnected and removed as part of the prior steps. The temporary 15 kV switchgear shall also be removed and salvaged.

l) Coordinate the initiation of the 66 kV primary revenue metering with Manitoba Hydro and the removal of the existing 4160 volt revenue metering.

The transitional work is now complete. New feeder installations to the new 12.47 kV switchgear line up for other NEWPCC plant loads would proceed as needed based on the expected NEWPCC upgrade implementation plan and schedule.

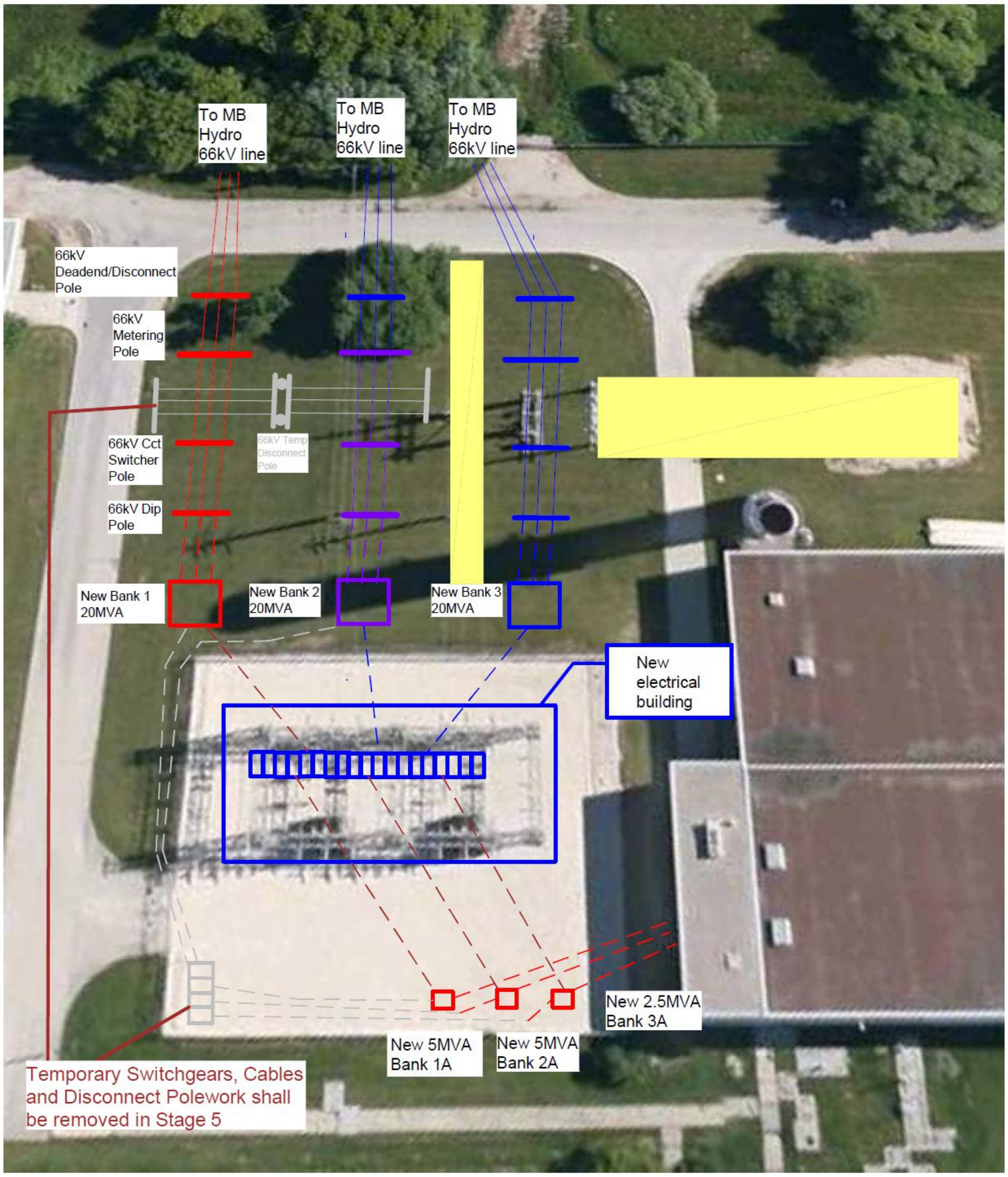


Figure 5: Stage 5 Work

5.0 SCHEDULE

The schedule for the establishment and tie-in of the new electrical service at the NEWPCC is governed by the requirement for power to the new facilities that will be coming on line at the plant. It is our understanding that the first areas requiring power will be the new raw sewage pumping plant and the new BNR basins.

Based on the present assumption that construction of these new facilities will commence around August of 2015, it is expected that new power will need to be available for no later than June 2017.

The implementation schedule for the electrical works will be governed by a number of factors including equipment delivery times, periods of favourable light loading and Manitoba Hydro's schedule to execute their portion of the work.

Long delivery items and expected durations as currently known are as follows:

1.	66 / 12.47 kV 20 MVA Transformers	12 months
2.	12.47 kV / 4160 volt 5 MVA and 2.5 MVA Transformers	6 months
3.	15 kV Fused Outdoor Switchgear	5 months
4.	15 kV Switchgear in a weatherproof building	up to12 months
5.	15 kV Cable	1 month
6.	5 kV Cable	1 month

Manitoba Hydro Constraints:

1. Salvage and remediation work on the existing substation must be coordinated and duration and timing for this work cannot be predicted at this time however, the duration for the work should not exceed 1 month if planned and coordinated properly. Sufficient time to execute this work exists in the current schedule.
2. Modification / removal to the 66 kV lines can only be done in September, October and November and in March, April and May. Since the spring period is not favourable for the City the fall period must be used.
3. Since the construction of the new substation at the NEWPCC must be executed with the full acceptance and coordination of all activities with Manitoba Hydro, it will be necessary to initiate their involvement at the earliest possible time. Once a firm concept for the new facility complete with a detailed estimate of total plant loads including a large motor list has been established, this should be reviewed with Hydro's distribution group to ensure that the proposed changes are aligned with their system. In particular, the ability to utilize the two 66 kV lines to provide interchangeable support for each of the transformer banks as well as overall capacity must be confirmed. Any changes that might arise need to be captured as early as possible to avoid unnecessary cost impacts or potential delays to the in-service date.

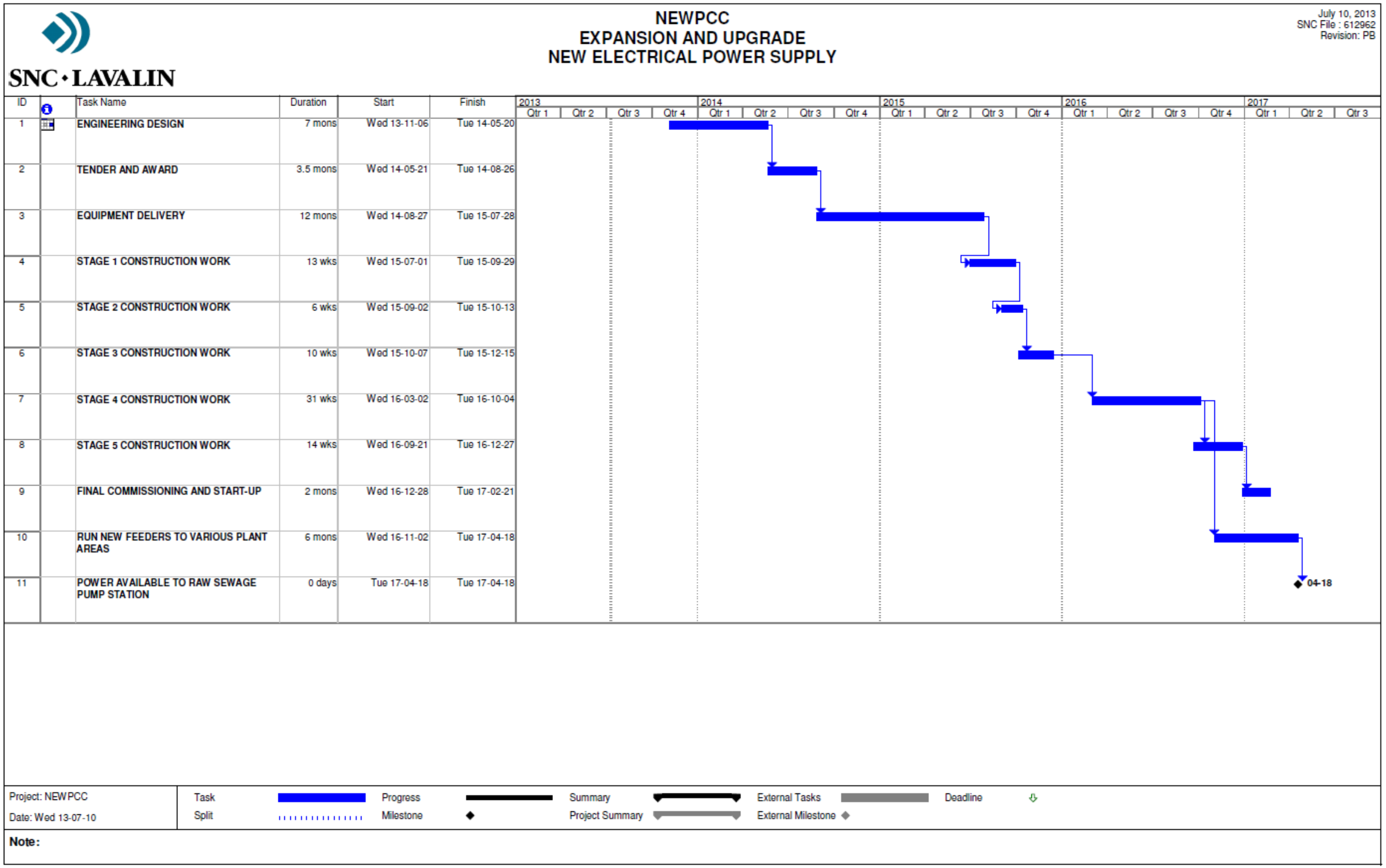
Based on the foregoing a proposed work schedule has been developed and is included in this section.

A table of milestone dates is shown below:

Activity	Completion Date
Engineering Design	May, 2014
Construction Contract	August, 2014
Long Delivery Equipment	August, 2015
Complete Stage 1	September, 2015
Complete Stage 2	October, 2015
Complete Stage 3	December, 2015
Complete Stage 4	October, 2016
Complete Stage 5	December, 2016
Final Commissioning and Start-up	February, 2017
System Fully Available for New Facilities	April, 2017

Table 2: Schedule Milestone Dates

SNC·LAVALIN	Technical Memorandum No. 4 Tie-in 7b New Electrical Power Supply	Document Code:	612962-0000-47ER-0001
		Revision	PB
Client: City of Winnipeg	Project: NEWPCC Expansion and Upgrade	Package / Area:	



ID	Task Name	Duration	Start	Finish
1	ENGINEERING DESIGN	7 mons	Wed 13-11-06	Tue 14-05-20
2	TENDER AND AWARD	3.5 mons	Wed 14-05-21	Tue 14-08-26
3	EQUIPMENT DELIVERY	12 mons	Wed 14-08-27	Tue 15-07-28
4	STAGE 1 CONSTRUCTION WORK	13 wks	Wed 15-07-01	Tue 15-09-29
5	STAGE 2 CONSTRUCTION WORK	6 wks	Wed 15-09-02	Tue 15-10-13
6	STAGE 3 CONSTRUCTION WORK	10 wks	Wed 15-10-07	Tue 15-12-15
7	STAGE 4 CONSTRUCTION WORK	31 wks	Wed 16-03-02	Tue 16-10-04
8	STAGE 5 CONSTRUCTION WORK	14 wks	Wed 16-09-21	Tue 16-12-27
9	FINAL COMMISSIONING AND START-UP	2 mons	Wed 16-12-28	Tue 17-02-21
10	RUN NEW FEEDERS TO VARIOUS PLANT AREAS	6 mons	Wed 16-11-02	Tue 17-04-18
11	POWER AVAILABLE TO RAW SEWAGE PUMP STATION	0 days	Tue 17-04-18	Tue 17-04-18

Figure 5: Proposed Schedule

6.0 POWER CAPACITY STAGING

Due to the extensive number of steps required to achieve the phased transition of the power supply for the NEWPCC facility, the amount of available power capacity during the transition process is not easily evident.

In an effort to clarify the capacity status at all times during the construction a graphical representation of installed and effective capacity has been included to provide a visual picture of supply capacity existing at any time.

Installed capacity has been presented as the sum total of in-service capacity based on the ratings of the equipment in question. As an example, the current installed capacity at the NEWPCC is 20 MVA (7.5 MVA for each bank plus 5 MVA for the UV DSC). The installed capacity is determined by the summation of the composition of all supply circuits and accounts for all new and any existing equipment.

Effective capacity is the available capacity of the power supply to power loads that are present in the distribution. It does not address redundancy or available capacity in the event of equipment failures.

As an example, the effective capacity of the UV transformer (PDT-1) under the normal operating configuration is 1 MVA rather than the 5 MVA rating of the transformer. This results from the fact that the total UV load is approximately 2 MVA and that the UV supply is split between PDT-1 and 4160 volt Bus #2.

Figure 6 provides a graphical representation of the power capacity during the transition period and is composed of three plots, namely:

- Total Installed Capacity
- Total Effective Capacity – Existing
- Total Effective Capacity – New

Several key areas are evident after review of the graph as follows:

- No new capacity is available until after 15 months of actual construction (the beginning of Stage 5).
- Effective capacity of the existing system is, for brief periods, as low as 6 – 7 MVA (Stage 3 beginning and Stage 5 beginning).
- Effective capacity during most of the work (Stage 3 and 4) is at 10 to 11 MVA.

Mitigation measures included in the phasing to counter these capacity constraints include:

1. Work scheduling in off hours and during light load (low flow) periods.
2. Installation of a capacity back-up measure (Bank 1 to Bank 2 lateral connection).

If these measures are felt to be inadequate, additional consideration would have to be given to the addition of spot standby / continuous diesel generator facilities (or other potential measures where feasible) to augment capacity.

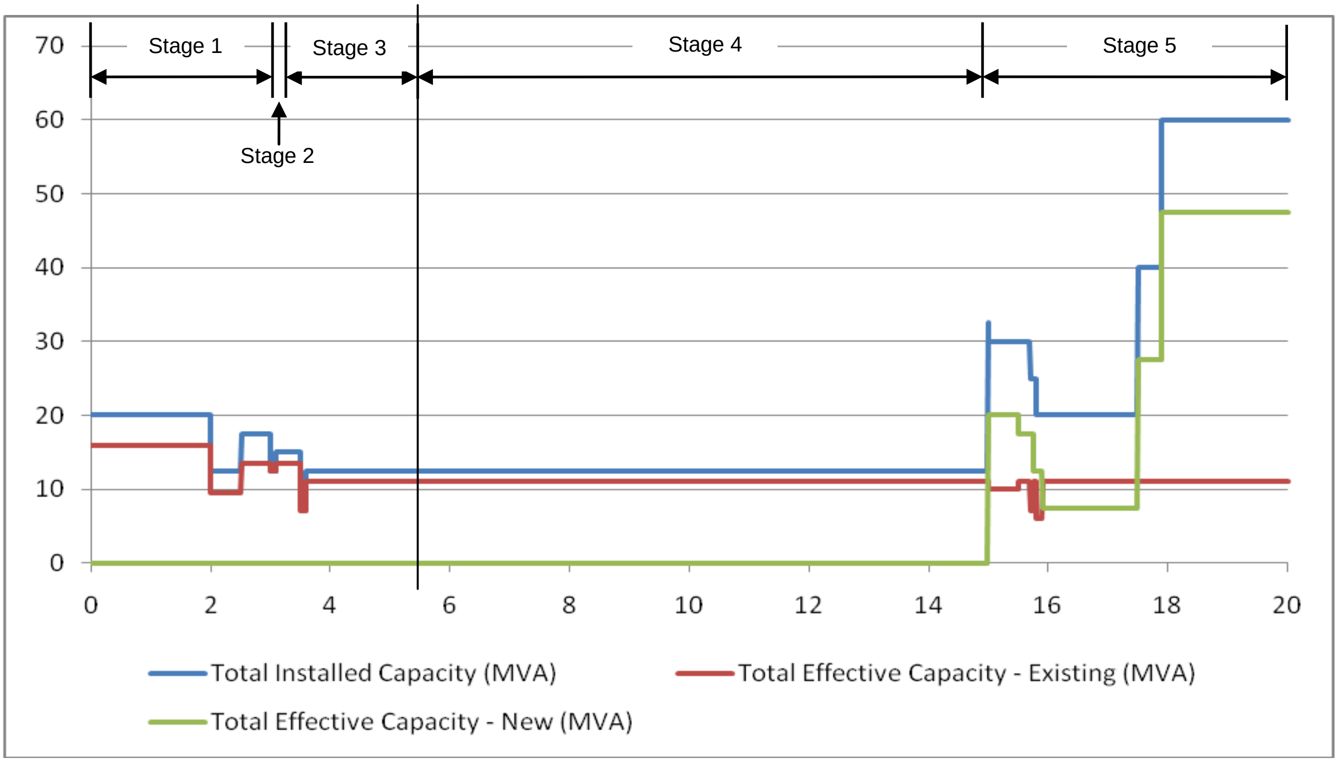


Figure 6: Installed and Effective Capacity

7.0 RISK ANALYSIS

(subject to revision based on the outcome of the formal risk review session)

A number of potential risk issues may arise during the course of execution of the work. A formal risk registry based on an interactive review between SNC-Lavalin, Veolia and the City of Winnipeg is part of the risk analysis discussed herein. Results of that analysis in tabular format are included in Appendix C. The major risk items identified are listed as follows:

1. Manitoba Hydro resources are not available to satisfy present schedule.
2. Manitoba Hydro may present system supply constraints that will prevent or dramatically change the proposed concept.
3. Environmental issues arise with the existing substation requiring unexpected remediation.
4. Power failures during construction when only one power line is available to supply the plant.
5. Equipment delivery delays.
6. Contractor availability.
7. Installation delays due to phasing, coordination and complexity.
8. Existing equipment failures (4160) during the construction period (main distribution and downstream equipment – more switching than normal).
9. Safety issues due to proximity of work with existing high voltage equipment.
10. Increased risk of operator error leading to a process upset during the transition period where operation is not as per normal practice.
11. Bank 1A and 2A sizing inadequate for existing plant demand.

8.0 COST ESTIMATES

The cost estimates shown herein are only those costs necessitated by the phasing measures needed to successfully achieve the tie-in of the new electrical supply to facilitate the intended plant expansion. In addition, any measures required for risk mitigation and their associated cost are also included. The cost estimates are not intended to cover the value of design, procurement, construction and start-up associated with a nominal installation but rather only those measures needed to achieve the successful completion of the work due to the special circumstances of the tie-in. The costs shown herein should, therefore be added to capital cost estimates for the installation that is being developed by others.

At this early stage, the level of accuracy of the estimates shown herein is Class 5 (+/- 50%). All values are in 2013 CDN dollars.

A tabulated breakdown of expected costs is detailed in Table 3 below.

Item	Description	Estimated Value
1.	5 MVA and 2.5 MVA, 12.47 / 4.16 kV Transformers	$350,000
2.	15 kV Temporary Switchgear	$125,000
3.	15 kV Cables and Terminations	$130,000
4.	5 kV Cables and Terminations	$120,000
5.	66 kV Line additions and modifications (Manitoba Hydro)	$250,000
6.	66 kV Standby Connection Between Bank 1 and Bank 2	$70,000
7.	Additional System Grounding	$25,000
8.	Miscellaneous Materials and Equipment (fencing, etc.)	$20,000
9.	Testing and Commissioning of Additional and Temporary Equipment	$15,000
10.	New 66 kV Revenue Metering and Consolidation	$75,000
11.	Heavy Equipment Rentals	$30,000
12.	Disconnection and Removal of Temporary Equipment	$30,000
13.	Existing Substation Salvage (Manitoba Hydro)	$100,000
14.	Extra Labour Due to Phasing	$125,000
15.	Overtime Premiums	$33,000
16.	Safety Watcher (HV Work)	$33,000
17.	Risk Contingencies	
17a	TBA	TBA
17b	TBA	TBA
17c	TBA	TBA
	TOTAL DIRECT COSTS	$1,531,000
	CONTINGENCY (35%)	$536,000
	TAXES (PST – 8%)	$165,000
	Engineering (Additional Design and Construction Services Associated with the phased implementation)	$350,000
	Indirect Costs – Owner (Finance and Administrative Charges – 3%)	$62,000
	TOTAL	$2,644,000

Table 3: Estimated Additional Tie-In Costs

APPENDIX A – DRAWINGS

APPENDIX B – NEWPCC

ELECTRICAL POWER UTILIZATION RECORDS

APPENDIX C – RISK REGISTRY

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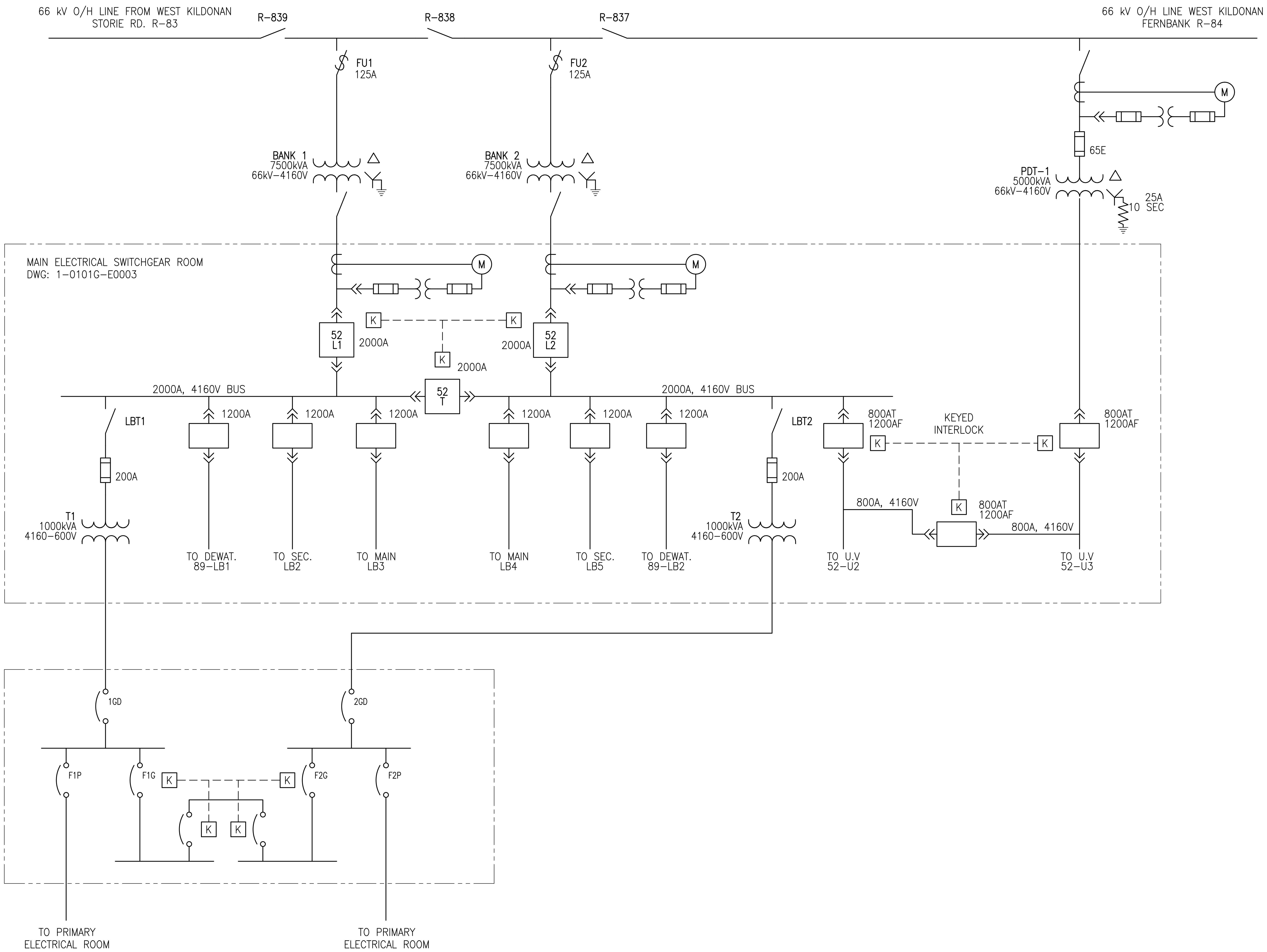

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PA	ISSUED FOR REVIEW	2013/05/29		

SNC·LAVALIN
SNC-LAVALIN INC.
148 Nature Park Way
Winnipeg, MB, Canada R3P 0X7
204-786-8080

DESIGNED BY: EXISTING	CHECKED BY:
DRAWN BY: K. MOHAMMED	APPROVED BY:
SCALE: NONE	RELEASED FOR CONSTRUCTION BY:
DATE: 2013/05/22	DATE:
CONSULTANT NO.: 612962-0000-47DD-SK01	

ENGINEER'S SEAL

Winnipeg
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
SINGLE LINE (PARTIAL) 66kV/4160V
EXISTING

CITY DRAWING NUMBER	SHEET	REV.	SIZE
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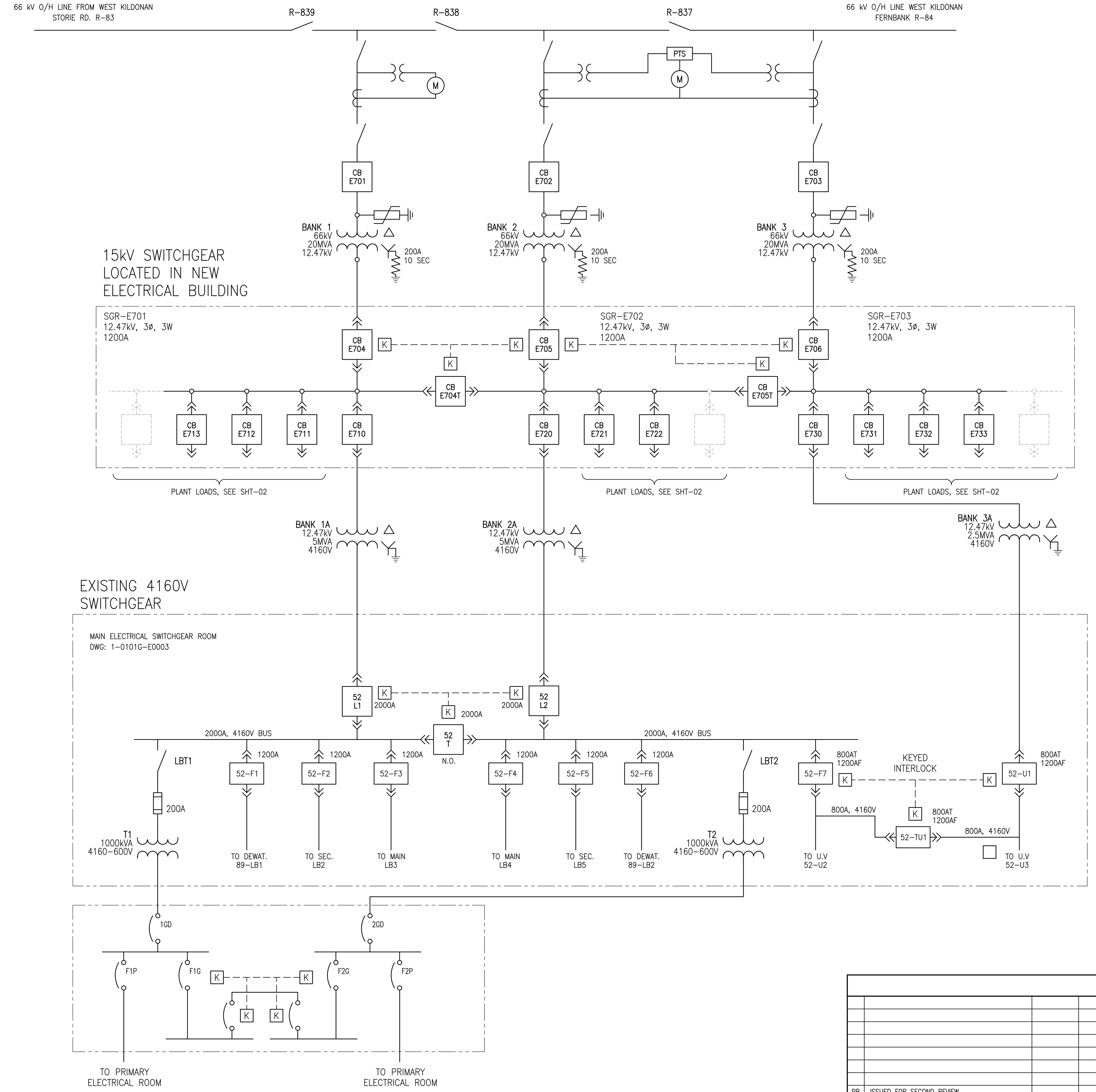

LEGEND:

PTS — POTENTIAL TRANSFER SCHEME

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NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
ULTIMATE SINGLE LINE

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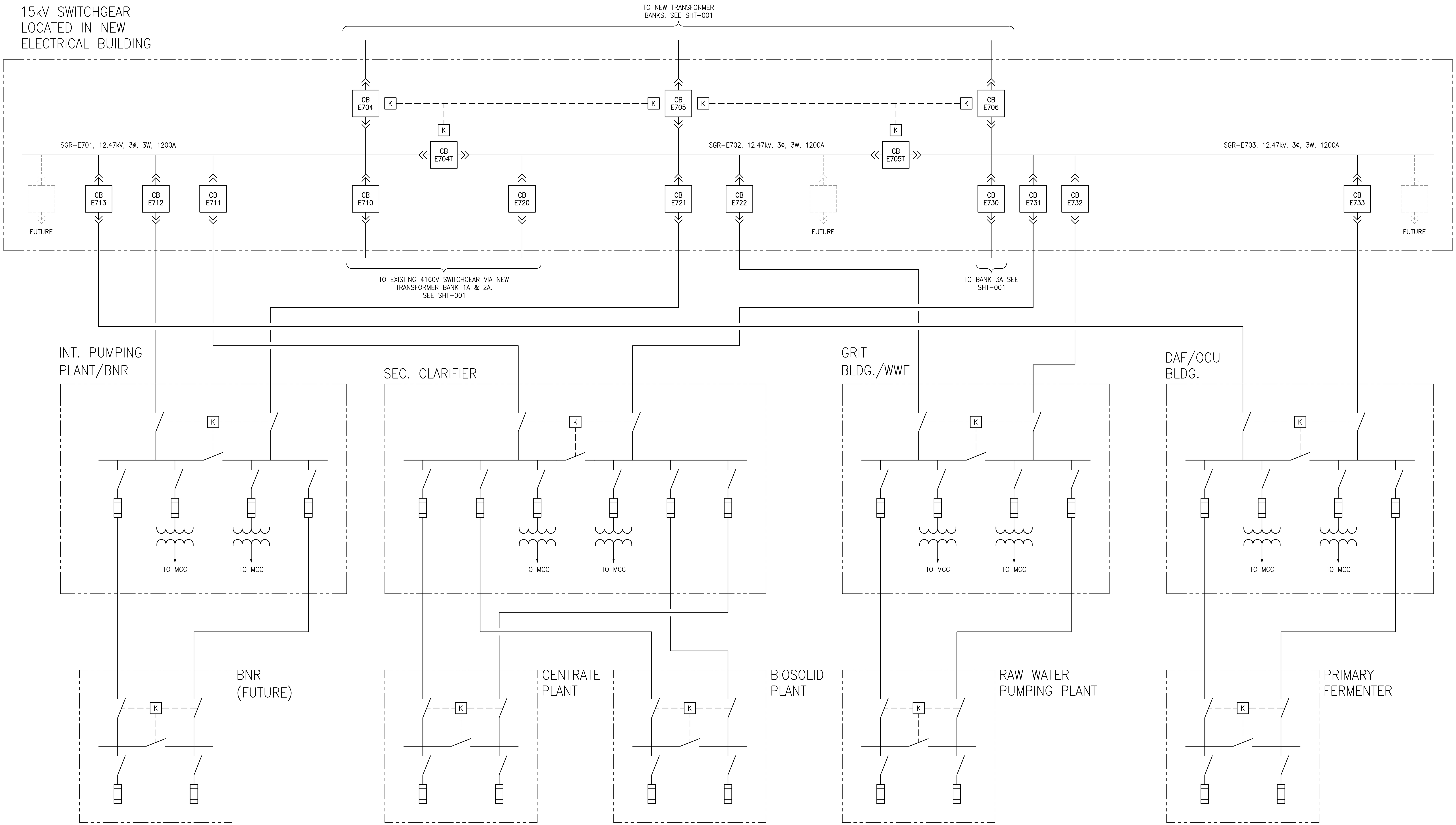

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SUBSTATION UPGRADE
ULTIMATE SINGLE LINE

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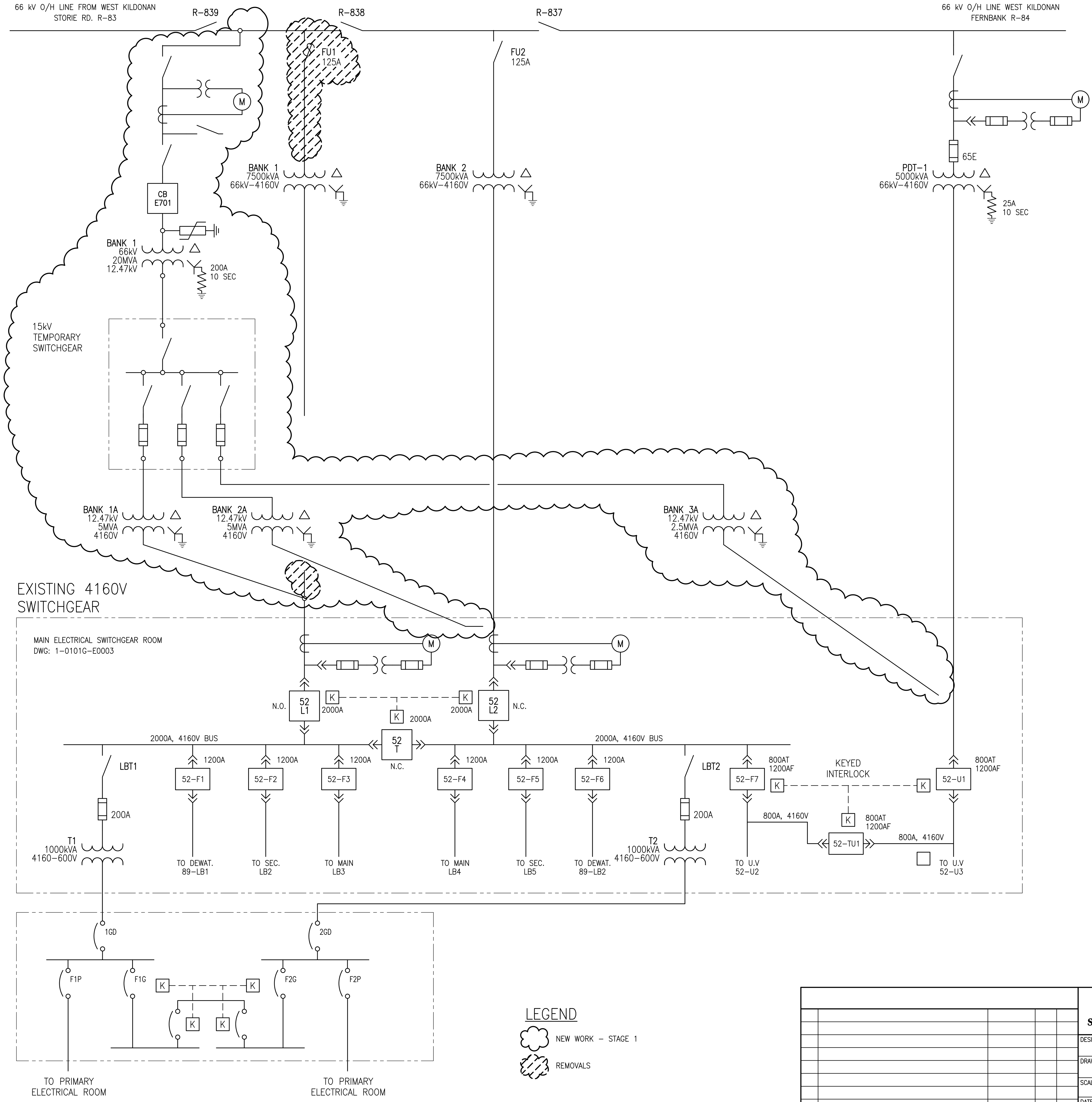

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CONSULTANT NO.: 612962-0000-47DD-SK03	

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NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
PROPOSED CONSTRUCTION STAGING
STAGE 1

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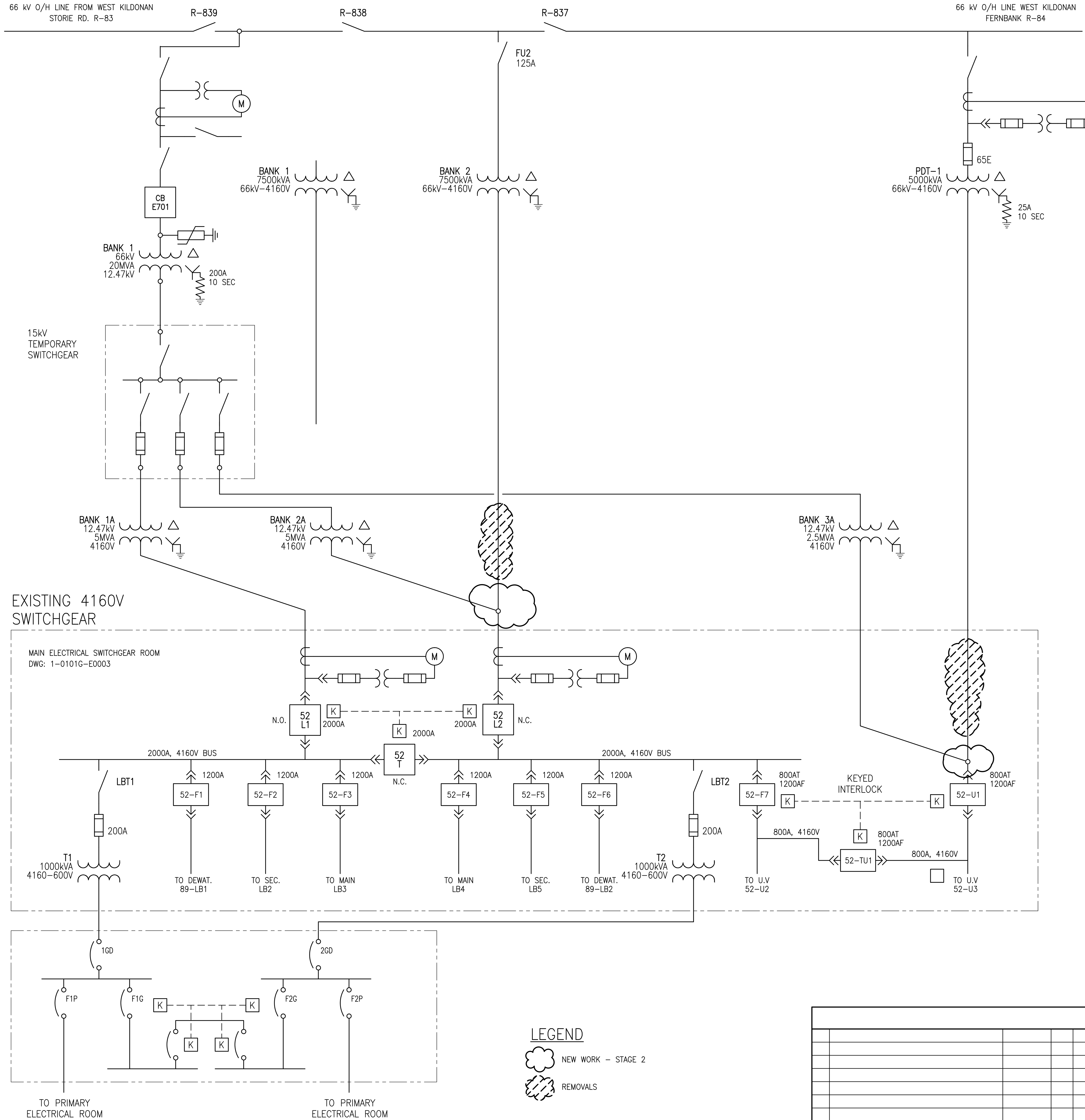

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NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
PROPOSED CONSTRUCTION STAGING
STAGE 2

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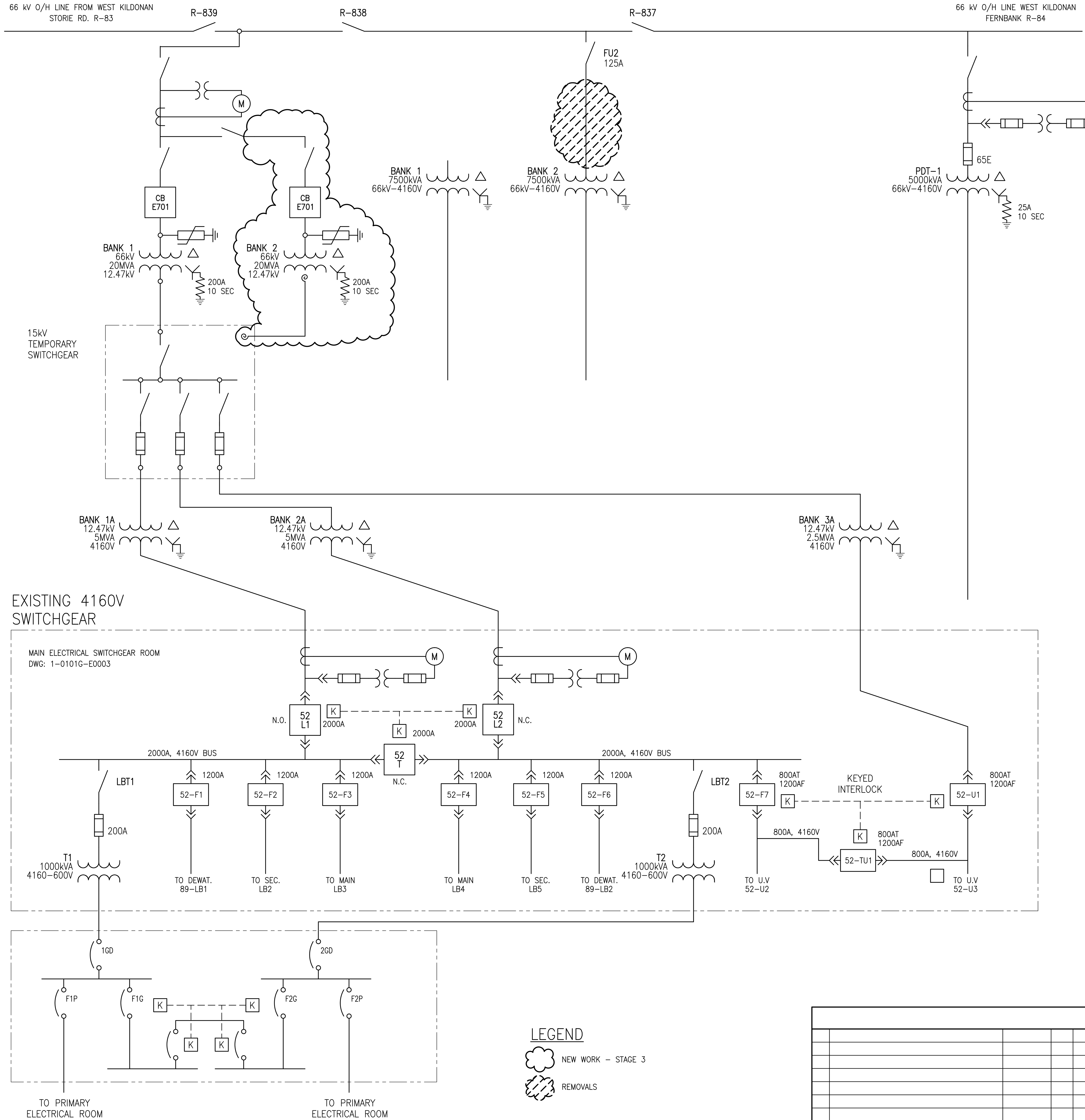

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BY:
DATE: 2013/05/24
DATE:
CONSULTANT NO.: 612962-0000-47DD-SK05

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WATER AND WASTE DEPARTMENT

NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
PROPOSED CONSTRUCTION STAGING
STAGE 3

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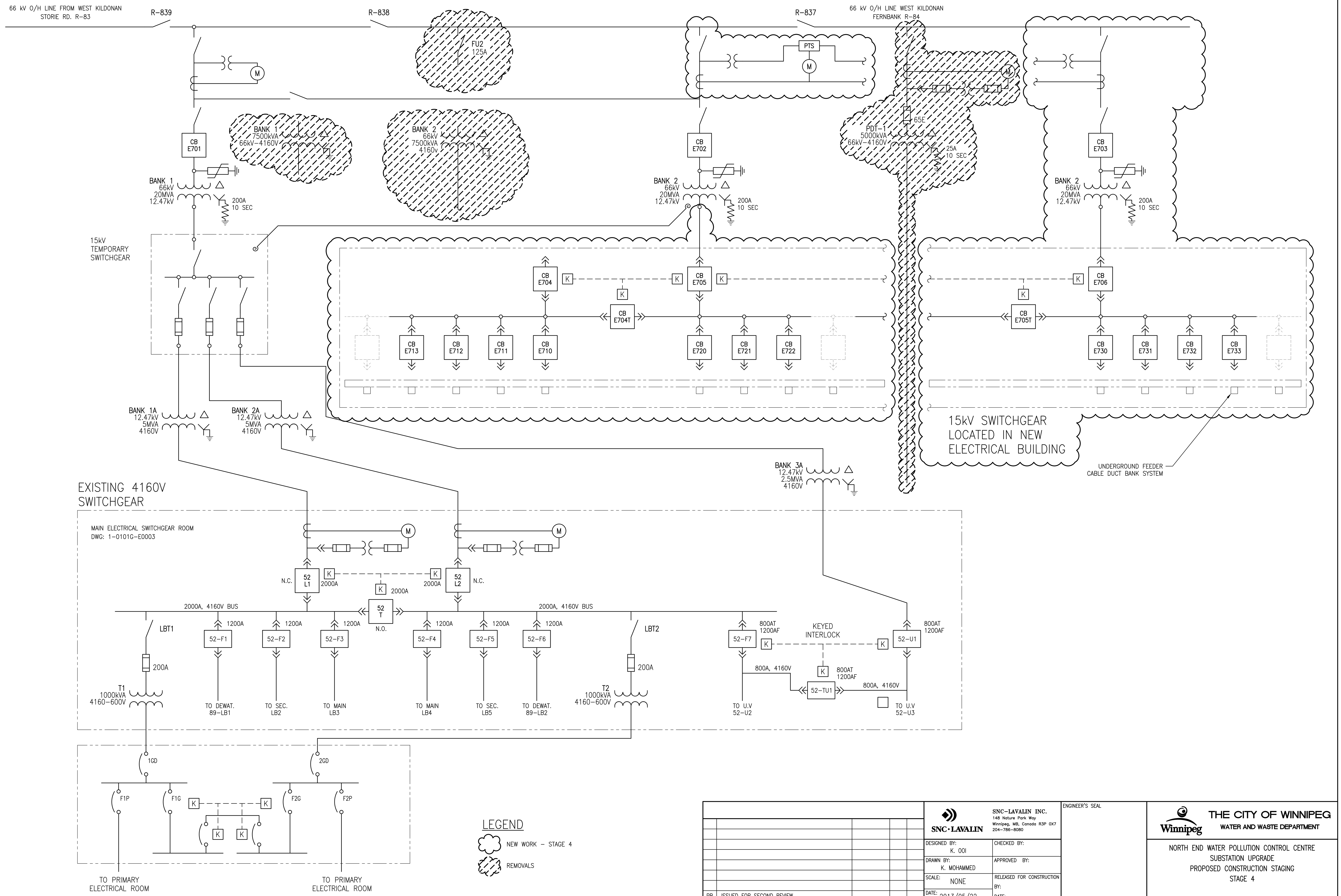

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Winnipeg, MB, Canada R3P 0X7
204–786–8080

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DRAWN BY: K. MOHAMMED	APPROVED BY:
SCALE: NONE	RELEASED FOR CONSTRUCTION BY:
DATE: 2013/05/22	DATE:
CONSULTANT NO.: 612962–0000–47DD–SK05	

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NORTH END WATER POLLUTION CONTROL CENTRE
SUBSTATION UPGRADE
PROPOSED CONSTRUCTION STAGING
STAGE 4

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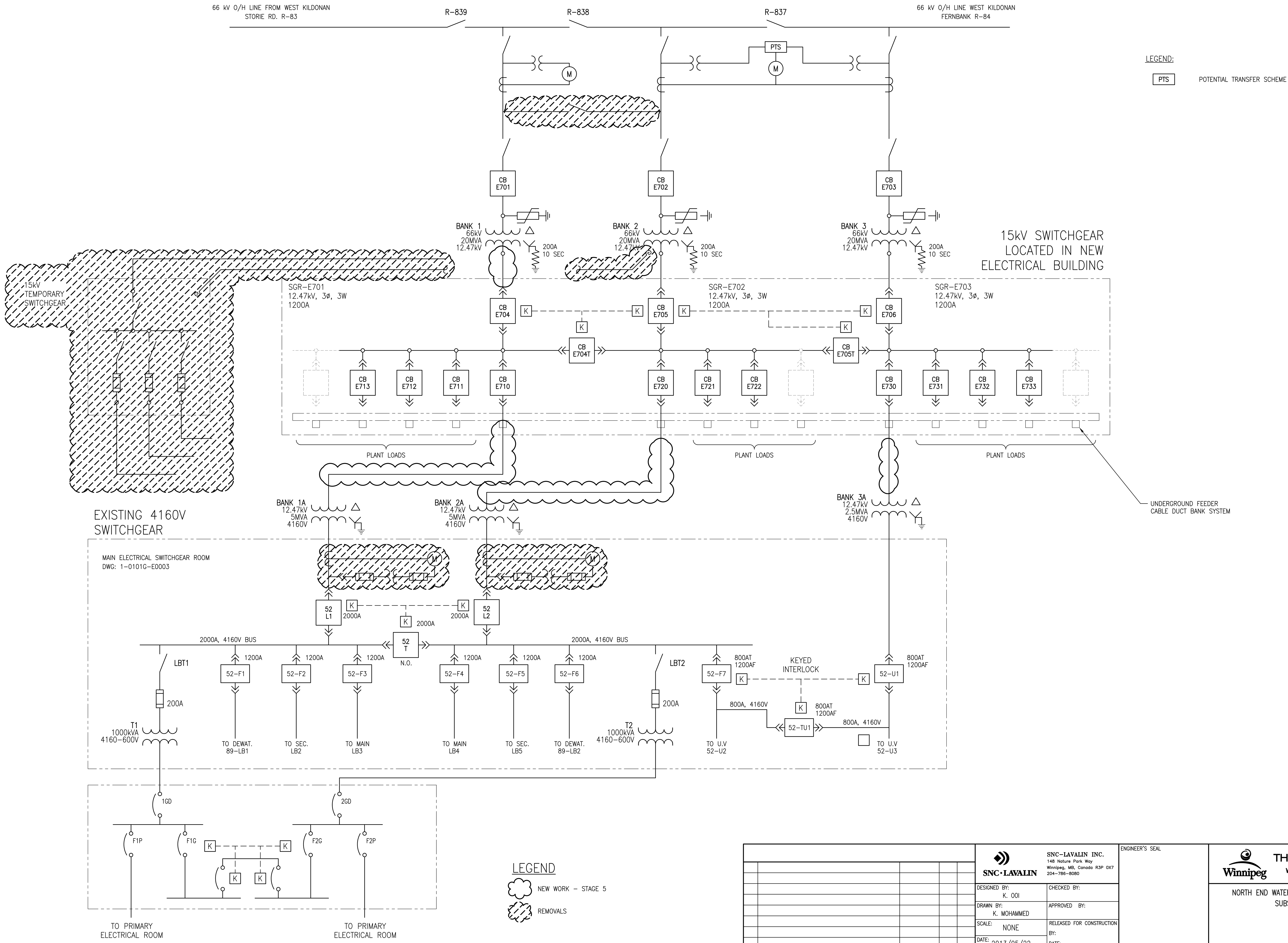

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DATE: 2013/05/22	DATE:
CONSULTANT NO.: 612962-0000-47DD-SK07	

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SUBSTATION UPGRADE
STAGE 5

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North End Water Pollution Control Center
2230 Main St.
8212554 - 6659181
GSM Electrical Service - Meter # 702796

Serv Month	Svc Cnt	Elec Days	Elec kW.h	Elec Bill Dem	% Load Factor	Elec Revenue
2013, MAR	1	31	3,026,736	6,099	66.2	$153,849.58
2013, FEB	1	28	2,705,439	4,947	80.6	$133,264.84
2013, JAN	1	31	2,964,023	5,057	78.0	$142,844.11
2012, DEC	1	31	2,970,618	5,255	75.3	$144,757.55
2012, NOV	1	30	2,883,375	6,395	62.1	$151,588.38
2012, OCT	1	31	3,165,075	6,536	64.6	$162,200.76
2012, SEP	1	30	2,914,733	5,104	78.5	$141,601.54
2012, AUG	1	31	2,994,620	6,381	62.6	$151,432.16
2012, JUL	1	32	3,108,129	6,051	66.3	$152,382.92
2012, JUN	1	29	2,972,148	6,441	65.8	$151,206.34
2012, MAY	1	31	3,205,815	6,628	64.5	$160,383.43
2012, APR	1	30	3,010,218	6,642	62.5	$154,118.46
2012, MAR	1	31	3,231,015	6,792	63.5	$159,010.66
2012, FEB	1	29	2,823,549	5,204	77.2	$132,932.73
2012, JAN	1	31	3,039,123	5,237	77.3	$140,000.48
2011, DEC	1	31	3,068,135	5,414	76.2	$141,972.08
2011, NOV	1	30	2,924,465	5,720	71.0	$139,999.98
2011, OCT	1	31	3,184,016	7,897	54.2	$166,330.60
2011, SEP	1	30	3,051,750	6,915	61.3	$153,971.94
2011, AUG	1	31	3,122,588	6,292	66.7	$151,011.11
2011, JUL	1	31	3,161,568	6,777	62.7	$156,280.80
2011, JUN	1	30	3,229,304	6,475	69.3	$155,898.54
2011, MAY	1	31	3,493,221	6,972	67.3	$168,359.08
2011, APR	1	32	3,607,205	6,812	69.0	$170,390.96
2011, MAR	1	29	2,964,954	6,606	64.5	$145,692.33
2011, FEB	1	28	2,784,806	5,528	75.0	$131,210.74
2011, JAN	1	31	3,658,352	7,833	62.8	$177,076.88
2010, DEC	1	31	3,890,292	7,895	66.2	$184,661.50
2010, NOV	1	30	3,746,441	7,059	73.7	$173,305.62
2010, OCT	1	32	3,379,205	6,763	65.1	$159,635.13
2010, SEP	1	29	3,199,112	7,095	64.8	$156,910.14
2010, AUG	1	31	3,318,114	7,253	61.5	$161,860.87
2010, JUL	1	31	3,256,254	7,258	60.3	$160,013.88
2010, JUN	1	30	3,344,270	6,980	66.5	$160,380.95
2010, MAY	1	31	3,413,780	7,013	65.4	$162,778.81
2010, APR	1	30	2,904,309	6,881	58.6	$146,137.29
2010, MAR	1	31	2,650,452	5,732	62.2	$123,745.69
2010, FEB	1	28	2,146,236	4,370	73.1	$97,969.28

North End Water Pollution Control Center
2230 Main St.
8212554 - 6659181
GSL Electrical Service - Meter # 717773

Serv Month	Svc Cnt	Elec Days	Elec kW.h	Elec Bill Dem	% Load Factor	Elec Revenue
2013, MAR	1	31	1,049,432	3,574	39.5	$52,836.16
2013, FEB	1	28	919,854	3,201	42.8	$46,735.27
2013, JAN	1	31	985,193	3,213	41.2	$48,723.19
2012, DEC	1	31	1,094,981	3,315	44.4	$52,557.21
2012, NOV	1	30	1,041,347	3,893	37.1	$54,584.03
2012, OCT	1	31	1,189,082	3,585	44.6	$56,986.47
2012, SEP	1	30	810,086	2,766	40.7	$40,832.03
2012, AUG	1	31	868,586	3,561	32.8	$46,336.86
2012, JUL	1	32	915,234	3,629	32.8	$48,074.85
2012, JUN	1	29	981,176	3,616	39.0	$49,879.44
2012, MAY	1	31	1,065,792	3,573	40.1	$52,029.89
2012, APR	1	30	862,713	3,489	34.3	$45,731.76
2012, MAR	1	31	1,048,791	3,862	36.5	$52,455.49
2012, FEB	1	29	729,273	2,851	36.8	$37,477.48
2012, JAN	1	31	712,575	2,760	34.7	$36,465.83
2011, DEC	1	31	702,081	2,796	33.7	$36,391.87
2011, NOV	1	30	673,949	2,695	34.7	$35,002.47
2011, OCT	1	31	556,382	2,954	25.3	$33,315.13
2011, SEP	1	30	707,522	2,802	35.1	$36,580.67
2011, AUG	1	31	851,178	3,115	36.7	$42,456.98
2011, JUL	1	31	931,421	3,159	39.6	$44,942.35
2011, JUN	1	30	948,615	2,911	45.3	$43,916.75
2011, MAY	1	31	1,166,219	3,025	51.8	$50,636.64
2011, APR	1	32	823,942	3,549	30.2	$44,255.21
2011, MAR	1	29	958,922	3,327	41.4	$45,954.23
2011, FEB	1	28	754,529	2,725	41.2	$36,807.69
2011, JAN	1	31	274,886	2,828	13.1	$24,533.99
2010, DEC	1	31	5,679	968	30.6	$6,020.58
2010, NOV	1	30	110,745	1,819	8.5	$13,999.50
2010, OCT	1	32	972,306	2,334	54.2	$40,299.46
2010, SEP	1	29	984,857	2,749	51.5	$43,149.81
2010, AUG	1	31	942,084	3,217	39.4	$44,836.49
2010, JUL	1	31	903,671	3,752	32.4	$47,048.49
2010, JUN	1	30	1,393,778	3,855	50.2	$60,855.72
2010, MAY	1	31	1,077,567	3,873	37.4	$52,457.77
2010, APR	1	30	802,643	3,259	34.2	$41,341.56
2010, MAR	1	31	1,054,221	3,289	43.1	$47,131.65
2010, FEB	1	28	714,120	2,220	47.9	$31,878.09

2010, JAN	1	31	2,407,527	4,117	78.6	$103,330.24
2009, DEC	1	31	2,361,629	4,219	75.2	$102,871.88
2009, NOV	1	30	2,302,425	4,241	75.4	$101,360.44
2009, OCT	1	31	2,352,671	5,544	57.0	$113,663.43
2009, SEP	1	30	2,529,134	7,604	46.2	$135,890.36
2009, AUG	1	31	2,527,826	5,495	61.8	$118,265.81
2009, JUL	1	31	2,645,804	5,465	65.1	$121,388.63
2009, JUN	1	30	2,558,495	5,957	59.7	$122,991.69
2009, MAY	1	31	2,636,337	5,818	60.9	$124,063.90
2009, APR	1	30	2,692,212	5,445	68.7	$122,552.53
2009, MAR	1	31	2,694,285	5,538	65.4	$119,859.20
2009, FEB	1	28	2,259,588	4,754	70.7	$101,450.96
2009, JAN	1	31	2,348,099	3,978	79.3	$97,399.32
2008, DEC	1	31	2,324,030	3,934	79.4	$96,369.88
2008, NOV	1	30	2,305,649	5,659	56.6	$110,260.35
2008, OCT	1	31	2,437,533	5,219	62.8	$110,192.76
2008, SEP	1	30	2,262,573	5,228	60.1	$105,485.79
2008, AUG	1	31	2,340,930	5,087	61.8	$106,452.49
2008, JUL	1	31	2,473,565	6,296	52.8	$120,154.78
2008, JUN	1	30	3,256,079	6,642	68.1	$138,449.40
2008, MAY	1	31	3,009,161	6,603	61.3	$131,826.99
2008, APR	1	30	2,952,057	6,243	65.7	$127,369.09
2008, MAR	1	31	3,125,981	6,298	66.7	$132,268.13
2008, FEB	1	29	2,815,668	5,121	79.0	$114,536.81
2008, JAN	1	31	2,971,107	5,044	79.2	$117,853.70
2007, DEC	1	31	2,927,805	4,793	82.1	$114,660.23
2007, NOV	1	30	2,823,741	4,826	81.3	$112,278.79
2007, OCT	1	31	3,028,428	6,680	60.9	$132,961.53
2007, SEP	1	30	2,928,212	6,196	65.6	$126,368.87
2007, AUG	1	31	3,088,416	6,821	60.9	$135,671.21
2007, JUL	1	31	3,156,932	6,340	66.9	$133,408.43
2007, JUN	1	30	3,231,635	6,851	65.5	$139,573.90
2007, MAY	1	31	3,143,088	6,286	67.2	$132,600.15
2007, APR	1	30	3,037,515	6,375	66.2	$130,648.81
2007, MAR	1	31	3,238,824	6,520	66.8	$136,990.52
2007, FEB	1	28	2,601,065	5,146	75.2	$106,416.22
2007, JAN	1	31	2,941,136	5,090	77.7	$114,257.01

2010, JAN	1	31	709,943	2,245	42.5	$31,918.35
2009, DEC	1	31	770,159	2,922	35.4	$37,578.43
2009, NOV	1	30	744,102	2,454	42.1	$34,070.86
2009, OCT	1	31	858,383	3,012	38.3	$40,400.21
2009, SEP	1	30	656,876	2,616	34.9	$32,802.36
2009, AUG	1	31	954,164	3,398	37.7	$45,206.83
2009, JUL	1	31	1,013,217	3,476	39.2	$47,203.49
2009, JUN	1	30	1,287,551	3,842	46.5	$56,500.16
2009, MAY	1	31	1,692,062	3,367	67.6	$64,056.28
2009, APR	1	30	2,069,561	3,806	75.5	$76,456.70
2009, MAR	1	31	1,358,447	3,758	48.6	$56,327.54
2009, FEB	1	28	748,709	2,910	38.3	$36,127.72
2009, JAN	1	31	690,413	2,694	34.4	$33,379.18
2008, DEC	1	31	748,971	2,107	47.8	$31,266.93
2008, NOV	1	30	899,882	3,481	35.9	$43,320.94
2008, OCT	1	31	931,101	2,724	45.9	$39,506.48
2008, SEP	1	30	866,322	3,637	33.1	$43,436.31
2008, AUG	1	31	905,439	2,946	41.3	$40,219.88
2008, JUL	1	31	938,463	2,604	48.4	$38,962.29
2008, JUN	1	30	1,124,693	3,018	51.8	$44,045.14
2008, MAY	1	31	914,483	3,535	34.8	$42,361.41
2008, APR	1	30	932,114	2,965	43.7	$39,311.23
2008, MAR	1	31	883,359	3,151	37.7	$39,324.03
2008, FEB	1	29	656,426	2,532	37.2	$30,376.31
2008, JAN	1	31	717,113	1,764	54.6	$27,112.06
2007, DEC	1	31	729,164	1,782	55.0	$27,497.29
2007, NOV	1	30	731,654	1,957	56.1	$28,615.55
2007, OCT	1	31	844,662	2,928	38.8	$37,087.68
2007, SEP	1	30	800,657	2,562	43.4	$33,861.47
2007, AUG	1	31	913,424	2,964	41.4	$38,880.04
2007, JUL	1	31	1,034,922	3,624	38.4	$45,662.16
2007, JUN	1	30	1,218,923	3,072	55.1	$46,529.85
2007, MAY	1	31	1,081,842	3,054	47.6	$43,282.00
2007, APR	1	30	1,000,955	3,115	44.6	$41,796.09
2007, MAR	1	31	1,106,751	3,192	46.6	$44,690.35
2007, FEB	1	28	734,873	2,796	39.1	$33,196.09
2007, JAN	1	31	752,291	2,538	39.8	$32,020.70