# EXPERT REPORT

# Analysis of Hydro-Quebec Request to Proceed With LAD Project, Phases II & III

Hydro Quebec AMI System
File R-3863-2013

Submitted By:

**Valutech Solutions Inc.**

3/12/2014

For

GRAME

And

The Quebec Energy Board

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# 1.0 Mandate

On October 28, 2013, Hydro-Quebec ("HQ") filed a Project Authorization Request with the Quebec Energy Board (the "Board") requesting authorization to proceed with Phases II and III of the Project Lecture à distance, ("LAD")[1], which was previously authorized for Phase I completion by the Board on October 5, 2012.[2] This authorization followed a lengthy evaluation and hearing process in which HQ presented its rationale for completing the LAD Project in three distinct phases.[3]

During the Phase I proceeding, HQ presented a multi-year budget and a technology solution which it believed represented a positive value proposition for its clients. HQ described the pilot program that was underway, the capital costs involved and the projected efficiencies and operating savings that would be achieved in the coming years. Upon review of the HQ file, the Board authorized Phase I deployment, subject to certain conditions which included periodic reporting of progress and results.

**Conclusion of the Board- R-3770-2011**

Upon review of all evidence and testimony in this case, the Board presented its decision in D-2012-127, which included the following paragraphs in Section 7.10 General Conclusion of the Board.

The Board in paragraph 532 asks Distributor to transmit, according to intervals specified below, the following information:

• *<u>Within a year,</u> a report communication plan for answering questions and concerns of its customers, the data on clients who have Opted-out and the withdrawal impact on deployment and costs of the Project;*

• *<u>Quarterly,</u> advancement monitor of the costs and schedule of Project, including the following information:*

- *o planning the installation of CNG per quarter for the Phase 1;*
- *o real number of CNG installed quarterly;*
- *o number of customers availing themselves of the option of withdrawal quarterly;*
- *o the anticipated costs of Phase 1 of the Project quarterly;*
- *o the actual costs of Phase 1 quarterly;*
- *o explaining differences in cost and schedule and new estimates, if any;*

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[1] File R-3863-2013 dated October 28, 2013.

[2] D-2012-127 dated October dated 2012.

[3] R-3770-2011 dated July 15, 2011.

*o status of materialization efficiencies announced;*
*o number of customer complaints received by quarter, classified according to the motifs type.*

• *Periodically and by the evolution of the project, present the state of advancement establishment of other features that are outside current perimeter but are considered by the Distributor, as the schedule filed at audience.*

**Current Filing R-3863-2013**

In its filing for Phases II and III authorization, HQ asked the Board to initially authorize network deployment in Phase II so that it could begin installing network communications in December 2013, and could begin meter installations in July 2014. HQ cited the need to begin installing the Landis+Gyr network 6-9 months in advance of the meters so that network communication with the new Phase II and III meters could be confirmed upon installation.

HQ further stated that a delay in approving the network installation would create a need to reduce the number of Capgemini meter installers currently completing work on Phase I, which would cause a loss of trained personnel that must be replenished later at additional cost. A smooth transition to Phases II and III would be more efficient and would enable Capgemini to retain and transition the experienced installers to the new phases of the project.

Hydro-Quebec estimated the network communications installation costs to be $6.4 million for the first six months, and the cost of delay in installing the meters to be $2 million per month for each month of delay. An expedited Board authorization was therefore requested.

Upon review of this filing, the Board rendered its decision in D-2013-196[4], which in part states as follows:

**Section 5. OPINION OF THE BOARD (D-2013-196)**

In paragraph 21, the Board agreed that the request cannot be separated from the comprehensive review of Phases 2 and 3 of the Project, and as a result included the decision D-2012-127 relating to Phase 1 of the Project.

Considering the overall context of the Project, as part of the R-3863-2013 request and the nature of work planned and described in the Authorization Request, the Board authorized in paragraph 22 the creation of a separate account to collect the off-base differences in order to account for all costs related to the installation of routers and collectors in specific regions of the phase 2 Project as well as in some Distributor installations.

[4] Board Response: D-2013-196 dated December 12, 2013.

The Board then concluded the following:

*[23] All amounts paid in the variance account will be subject to review by the Board for their necessary and prudent character within the full study. This case is presented by the Distributor under Section 73 of the Act.*

*[24] The Board emphasizes that this decision does not constitute an authorization Phases 2 and 3 of the Project.*

*[25]* ***For these reasons,***

***The Régie de l'énergie:***

***DENIES*** *the priority application of the Distributor.*

**GRAME Intervention**

On November 22, 2013, the GRAME filed a Request for Intervention for LAD Project, Phases II and III, citing a number of concerns that would need to be addressed and requesting intervener status. GRAME also requested Board approval to bring in an industry expert to file an independent expert report. In its filing, the GRAME raised a number of concerns about the technology and cost, including in part:[5]

**The scalability of Technology**

*13. GRAME's concern, followed by the decision D- 2012-127 which is in line with its interests and monitoring issues addressed during Phase I of the Project , the ability of evolution of the technology used and the estimated costs of the Project, taking into account the status reports filed by the Distributor in monitoring this decision;*

*14. Followed by its intervention in phase I of the LAD Project ( R- 3770-2011 ) GRAME wants to ensure that the technology used by the Distributor is scalable and will provide new services to customers and implement measures of network management, including monthly billing, that should be available in Phase I, while it is not yet operational ;*

*15. At this point, GRAME believes that the results of Phase I of the project do not demonstrate that the technology choice made by the Distributor will achieve one of the objectives mentioned in paragraph 11 of its application authorization, or that this technology allows " the possible offering of new services to customers and improving the quality of service delivery", at optimum cost ;*

[5] Please note: Some paragraphs have been edited for clarity in English and to account for minor discrepancies that occur in translating from French to English.

*17. The Distributor announced that following the introduction of AMI, it worked on projects related to the new technology to provide possible new customer service technology. In this regard, GRAME wants to check the status of these options (Demand management , electrification of transport pricing) to ensure that the technology selected by the Distributor is adequate to support them and to ensure that the Distributor explores these benefits including demand response supply and demand programs in order to optimize these investments;*

***Work on Phase I and Impact on Phases II and III***

*19. Concerning the work of Phase I, GRAME notes that 45% of meters were installed to 25 October 2013 (about 850,000, but no Elster polyphase meters), although according to the Distributor the AMI network deployment is nearly completed. The evidence also indicates that the Distributor claims 75% of the installation of routers and collectors have been completed;*

*20. GRAME is concerned by statements to the effect that phase I expected costs, and the network's capacity to fulfill its role of data collection as well as the capacity of the mesh network to be scalable, does not fully include the number of interdependent routers and collectors that will be installed . Thus, the costs will vary depending on the number of routers and collectors, and even if the costs can be below those expected based on the evidence , the Distributor does not mean that the choices made in terms of AMI network technology or all network features have been delivered, or that the initial plan was followed and that these choices are optimal for the desired objectives ;*

*21. In this regard, GRAME addresses the issue of the absence of sufficient collectors with respect to the evolutionary performance of the AMI system, including with respect to the latency for the connection / disconnection and the required bandwidth for the implementation of new features. It had been shown that this feature would be established in Phase I for residential or commercial meters;*

*24. GRAME deposits have demonstrated to the Board that a new version of collectors is available on the market since July 13, 2011 and the Distributor did not retain this version for the deployment of Phase I of the LAD Project. GRAME indicated that although the software component can be updated remotely, the risk lies in the additional memory required to ensure network scalability and adding features for the benefit of customers. Therefore, GRAME wants to check if the two versions are compatible and if the Distributor may use for phases II and III;*

*25. In addition, the fact that no commercial polyphase meters have been installed and connected to the network at this stage Gridstream Phase I remains a major concern for GRAME. Many of these meters are located in downtown Montreal, which is the center of Phase I, and the account GRAME prove, through the testimony of an expert in intelligent network, the fact that the network cannot be fully tested without installing commercial meters and connecting to EnergyICT;*

***Telecommunications Coverage***

*26/27. Distributor says in his evidence that cellular coverage has increased considerably and it opts for the use of cellular connections for the vast majority of collectors and territories covered by phases 2 and 3. When requesting approval of Phase I of this case, the R- 3770-2011 file GRAME interpreted the position of the expert to the effect that all tests to reduce technological risks have not been successfully completed , including evidence of connectivity with the satellites on the ground;*

*28. GRAME recalls that when the request for approval of Phase I of the LAD Project, its expert, Mr. Finamore , expressed doubts about the availability of the satellite connection for data delivery specifications Gridstream RF Series IV collectors who were selected and the tests were not carried out successfully for satellite modem connection ;*

***Technical Evaluation Issues***

*31. GRAME believes that many elements should be reviewed prior to finalization of specific decisions about the technology to be used for phases II and III, including those related to reading data in remote areas. While these are technical in nature, they are particularly related to the potential across the LAD project to be able to take in the future new features and to integrate them for all customers supplied by the Distributor, including one of the most remote regions;*

*32. In this regard, GRAME notes that the evidence presented by the Distributor, it is not clear whether commercial clients have benefited from the installation of new meters, or if specific meters for these clients are operational. In addition, the evidence does not indicate whether the provider of metering Elster has received approval from Measurement Canada or whether Landis + Gyr has received approval from Industry Canada to perform the remote over the air updates of meter registers;*

*34. As proof, the Distributor seemed to consider using a WiMAX system communications network. In this regard, GRAME wishes to verify a technical point of view the impact on the performance of LAD project and the reasons for abandonment of this technology and the impact on long term telecommunications costs;*

***Costs and Cost Projections***

*36. On the costs of phases II and III , the evidence indicates that the Distributor bases costs of purchasing and installing meters in Phases II and III arising from requests for proposals made in the preparatory work ;*

*37. GRAME is concerned about this situation since several technical points (latest version meters and collectors suitable for scalable capacity increases to use a satellite connection) must be confirmed before the Distributor definitely fixed agreements with its suppliers to phase II and III ;*

*38. GRAME wants to ensure an updated project cost before deployment of phases II and III;*

*39. Distributor requests that Phases I, II and III are incorporated into a single project for monitoring. A priori GRAME is in favor of such a procedure , as long as when submitting monitoring, cost details to be provided separately for each of these phases and provide the Board with the reasons for the request in more detail in his evidence ;*

## 1.1 Framework for Intervention

Subsequently, the Board issued its guidelines for intervention by various parties including the GRAME's Demand For Intervention.[6] The Board provided its response to the intervener's requests in D-2014-004[7], which reads in part as follows:

**Section 3. FRAMEWORK FOR INTERVENTION**

In paragraph 28, the Board emphasizes that inquiries, papers and other evidence submitted by stakeholders must be relevant to the analysis of this Distributor's request, be directly linked to the project as presented in its entirety in case R -3770-2011 formally consider the findings made by the Board in its decision D-2012-127 and follow the analytical framework set out below.

In paragraph 29, the Board states:

*This case is submitted under section 73 of the Act. Pursuant to Article 2 of the Regulation on the conditions and the cases in the authorization of the Régie de l'énergie and whereas investments related to phases 2 and 3 are a project of more than $ 10 million, the current demand Distributor must therefore include the following information:*

- *The objectives of the project;*
- *Description of the project;*
- *Justification of the project in terms of objectives;*
- *Costs associated with the project;*
- *The economic feasibility studies and sensitivity analyzes;*
- *The impact on prices of electricity distribution;*
- *The impact on the quality of service delivery of electricity distribution;*
- *Alternative solutions to the project.*

[6] See GRAME filing for File R-3863-2013 dated November 22, 2013.

[7] See Procedural Decision on Requests, Issues, Timing and Modalities of Processing the Application, D-2014-004, paragraphs 30 and 31 dated January 15, 2014.

Ruling D-2014-004 further states:

Paragraph 33 requests the Distributor to update the following tables, while adding the necessary explanations to supplement the evidence in the record, in compliance with Article 73 of the Act, and to adjust for the fact that the installation of new generation meters began not in 2012 but in 2013:

- *Economic comparison of scenarios ($ M updated 2011), but only data on IMA scenario;*
- *Tariff impact scenario IMA;*
- *Depreciation, radiation and number of devices (meters) withdrawn;*
- *efficiency gains provided;*
- *AMI functions planned for implementation by the Distributor.*

The Board also requested in paragraph 34 that the Distributor in accordance with the D-2012-127 decision to file in this case the monitoring report of Phase 1 of the Project until 31 December 2013.

And in paragraph 35 the Board directed interveners to strictly limit their performances, testimonies, arguments and pleadings to issues specific to phases 2 and 3 of the Project, the information included in the monitoring of phase 1 of the project, and the subjects specified in this decision.

## 1.2 Basis for This Report

In accordance with the above motions and filings, GRAME has engaged the services of an independent industry specialist, Valutech Solutions, Inc., to examine the record in this file and prepare an independent written report for the Board documenting its findings. This report must comply with the Board's decisions and permitted areas of inquiry in connection with its January 15, 2014 decision.

To that end, Valutech has examined the available documents, motions, findings and responses to questions that have cumulatively become the official record in this case. While performing an independent evaluation of this file, we have attempted to strictly follow the Framework for Intervention approved by the Board, recognizing the topics excluded in paragraphs 30-32, and provide a summary of conclusions, risk factors and specific recommendations that should be considered by the Board pursuant to making a final decision in this proceeding.[8]

Under the Board's ruling in D-2014-004, and in accordance with the Act, HQ must provide information related to the following specific areas:

- Costs Associated With the Project
- The Economic Feasibility of the Project
- Sensitivity Analysis
- Impact on Price of Electricity and Quality of Service

In accordance with this ruling, HQ was directed to adjust its request to account for the delay in installing meters from 2012 to 2013, and to update various tables and explanations. Updated quarterly reports through December 31, 2013 were requested, and two work sessions were scheduled to discuss technical and cost related issues. The Board also directed interveners to comply with its ruling that included addressing only the above issues and Phase I of the Project.

Valutech Solutions has endeavored to fully comply with the Board's request to limit its efforts to the issues approved for review in this File. To that end, we have examined the progress and choices made in Phase I, to attempt to determine their effects on total LAD project cost and their ability to produce the required efficiency gains. We have identified unknown data points, and problem areas and risk factors that the Board should consider that could jeopardize the efficiency gains, future client benefits and increase project cost.

## 2.0 Hydro-Quebec Authorization Request

On October 28, 2013, Hydro-Quebec filed a Project Authorization Request with the Quebec Energy Board seeking to proceed with Phases II and III of its LAD Project.[9] In its filing, HQ asserted that it had made substantial progress towards completion of Phase I, which was previously authorized by the Board on October 5, 2012.[10] According to HQ, the Phase I progress included the following:

- *HQ installed the AMI system, including the Landis+Gyr Gridstream head end software, the EnergyICT meter data management system and associated interfaces*

[8] This file is being handled under Section 73 of the Quebec Energy Board Act "the Act" since it represents a project of more than $10 million.

[9] R-3863-2013 dated October 28, 2013.

[10] D-2012-127 dated October 5, 2012.

- *Installed 75% of the Phase I Landis+Gyr network collectors and routers, and 634,000 new generation electric meters (45%) by September 30, 2013*
- *Daily read rates have reached 99.4% as required, and 99.9% of client bills are based on an actual vs. estimated reading*
- *The SAP billing system has been integrated with Gridstream and is fully operational*

HQ also requested a priority decision from the Board in order to permit it to begin installing network equipment and have this equipment in place when Phase II and III meters are installed beginning in July 2014.[11] A 6-9 month lead time was requested by HQ in order to have the Gridstream network in place for the meter installations. If an early start to Phase II and III deployment was not approved, HQ claimed that additional project costs would be incurred:[12]

- *Capgemini meter installation personnel would be terminated, with a resulting need to retrain other installers once the project resumed*
- *Additional costs for warehousing, maintenance and vehicles would be incurred*
- *Combining Phase II and III authorization would improve efficiency and logistics when deploying the network*

HQ provided a revised schedule that would extend the project through 2018, and expects to complete the project approximately $13.1 million under budget. The Phase II and III Authorization Request provided some general information on project risks and economic feasibility of the project. For efficiency purposes, HQ requested authorization for both Phases II and III, so that overlapping networks and work crews could perform the remaining work in the most effective manner.

## 3.0 Phase I Installation Status

On January 27, 2014, HQ submitted its final Quarterly Report that will be available for detailed review prior to the April 2014 hearing for this file.[13] In its report, which includes progress made through December 31, 2013, HQ provided a project cost update showing a projected Phase I savings of $13.1 million, which results in a revised total Phase I cost of $427.4 million.[14]

[11] R-3863-2013 dated Oct. 28, 2013, page 4.
[12] HQD-1, Doc 1 dated October 28, 2013, section 3.3.
[13] HQD-1, Doc 2 dated January 27, 2014.
[14] See Table 2 of HQD-1, Doc 2, pg 9.

This projected result is largely dependent on a number of factors which remain at issue and have not been completely addressed in the report. HQ has not provided sufficient information in its quarterly reports to adequately project a final cost. Valutech Solutions believes that Phase I meter installation issues, technology risks and network performance questions have not been reported on in a manner that would permit the Board to make a reasoned judgment concerning the overall viability of the total project when considering HQ's Phase II and III Authorization Request.

## 3.1 Meter Installation Progress

In its December 31st report, HQ stated that a total of 1,037,000 meters had been installed for Phase I to date, which represents approximately 61% of the 1,700,000 Phase I meters overall. During this same period, a total of $142.8 million was expended for meters and installation, which represents an average of $137.70 per installed meter. Based on information provided to date, including the discussions held with HQ in the February 14, 2014 work session, we believe that these installations are mostly residential meters.

HQ has stated that approximately 70% of meters in Montreal, which makes up most of the Phase I installation area, are located inside the building.[15] This does not include other locations with locked barriers that also require appointments or special arrangements to gain access. If adjusted for the suburban areas, a reasonable estimate is that 65% of Phase I meters, or approximately 1,100,000 meters, are located inside.

According to Hydro-Quebec's May 2012 presentation to the Energy Board, Capgemini's contractual requirement for completion of Phase I and II meter installations is a minimum of 94%, with a potential maximum completion rate of 97-98%, or a maximum of 3.25 million meters completed in these two phases.[16] Since there are 3.4 million meters contained in Phases I and II, this appears to leave as many as 150,000 meters, including thousands of commercial and polyphase meters, in these two phases for HQ to complete with its own staff or by extending the Capgemini contract.[17] Perhaps 60-70% of the 317,290 commercial meters are included in Phase I.

If Capgemini is required to make three separate attempts to complete an installation before returning an incomplete work order to HQ, it seems reasonable to assume that most of the turn backs will be for inside meters where Capgemini could not gain access. These more difficult meters with access problems will take much more time and expense to complete, and were likely

[15] See HQD-1, Doc 1, Section 2.2.2 dated June 30, 2011, and response to Q1.4, HQD-2, Doc 6.1.

[16] HQD-8, Doc 1 Section 5 Meter Installation Performance, dated May 2012.

[17] See Reference R-3854-2013, B-0045, Table 15, page 28. HQ states that there are 317,290 commercial meters in the project, and it is reasonable to assume that a majority of these meters are located in the large commercial areas of Montreal, Laval and other Phase I suburbs.

not sufficiently accounted for in the 2014 HQ installation costs included in the December 31st report.

As mentioned above, we estimate that approximately 1,100,000 inside meters are located in Phase I, and given the special attention and return trips that are typically required to complete these installations, it is not likely that HQ can complete the potentially large number of turn backs that are still to come from Capgemini within the projected average cost of $150.08 per meter that has been allotted for the remaining Phase I meter installations in 2014. See Table 1 below:

**Table 1 – Purchase and Install Meters**

| | Preparatory | 2012 | 2013 | Jan-June 2014 | Phase I Total | Total Project |
|---|---|---|---|---|---|---|
| Cost | $4.4 M | $3.2 M | $135.2 M | $98.0 M | $240.8 M | $583.1 M |
| Meters | 20,000 | 0 | 1,017,000 | 653,000 | 1,690,000 | 3,800,000 |
| Cost/Meter | $220.00 | --- | $132.94 | **$150.08** | $142.49 | $153.45 |
| Phases II & III | Remaining Cost: $342.3 M | | Remaining Meters: 2,110,000 | | Projected Cost/Meter: $162.23 | |

### 3.1.1 Commercial and Polyphase Meter Installations

An additional area of concern is the lack of progress that has been made in installing commercial and polyphase meters in Phase I. In a response to GRAME's questions, HQ stated that there are nearly 120,000 polyphase meters in the LAD Project, and it is reasonable to assume that a majority of these meters are located in the major commercial areas of Montreal, Laval and other Phase I suburbs.[18] Since Montreal and suburbs includes a large number of commercial areas, the Phase I deployment area cannot be considered complete until HQ's polyphase meter solution has been approved by Measurement Canada (MC), and the Elster meters to be used for this purpose have been purchased, installed and are being read over the Gridstream network.

HQ's Phase I Authorization Request and its Meter Replacement Plan did not state that commercial and polyphase meter installations located in the Phase I area would be deferred until Phase II and III of the project. Since the purchase and installation cost of these meters is substantially higher than the cost of residential meters, excluding them from Phase I would represent a significant transfer of work scope and cost to future stages of the LAD project. This approach was not included in the Phase I Meter Replacement Plan authorized by the Board.

HQ appears to assume that the Elster commercial and polyphase meters will eventually receive MC approval, and that once Phase II and III authorization has been received, these meters can then be manufactured, shipped and installed at a later time without regard for the timing of

[18] See response to GRAME question 2.4, B-0038, HQD-2, Doc. 4.1.

Phase I completion. This approach is not recommended because it blurs the end of Phase I activities, and would prevent the Board from receiving a Final Completion Notice that includes the actual Phase I cost. The prospect of incurring unauthorized Phase I budget overruns is much higher under this scenario.

It is highly unlikely that the large number of more expensive Phase I commercial and polyphase meters can be purchased and installed at the average price of $150.08 per meter that is assumed by HQ in its Phase I meter installation budget for 2014 (See Table 1). These more advanced meters are significantly more expensive to purchase than residential meters. While actual pricing has not been made available to us, the actual cost to purchase the Elster polyphase meters can be easily verified by the Board, which has access to the project's confidential pricing schedules.

Since Elster must apply for and receive MC and Industry Canada (IC) approval for any new versions of its residential and polyphase meters that will record usage and receive over the air firmware updates, HQ seems unprepared to address the possibility of any extended delay in receiving these approvals. In our view, any significant delay could create an increased potential to negatively impact the LAD Project schedule and cost. Valutech notes that HQ has not included this potential for schedule and cost risk caused by extended MC and IC approval delays among the risks associated with the project.[19]

### 3.1.2 Potential Cost Impact of Meter Installation Issues

From the information provided to us, it is not possible to precisely calculate the impact of the above described meter installation issues on Phase I project cost. The average cost for HQ's completion of inside meters has not been provided. However, if some reasonable assumptions are applied to the situations described above, we believe that it is likely that HQ could experience some significant Phase I cost increases beyond its current forecast of $427.9 million.[20] For example:

- Since approximately 1.1 million Phase I meters are located inside, and nearly 1.2 million total inside meters for Phases I and II,[21] it is reasonable to assume that approximately 92%, or nearly 138,000 inside meters, including commercial and polyphase meters, must eventually be completed for Phase I. This represents a potential additional cost exposure of millions of dollars.

[19] Note that HQ has not listed this regulatory risk in Section 6 of its Phase II and III filing HQD-1, Doc 1, dated Oct. 28, 2013.

[20] See HQD-1, Doc 1, Section 1 Introduction dated October 28, 2013.

[21] In HQD-1, Doc 1 Section 2.2.2 dated June 30, 2011, HQ states that 35% of all meters are installed inside the building. This projects to an approximate number of 1,190,000 inside meters for Phases I and II.

- Since MC approval has not yet been received for the Elster polyphase meters, it is likely that the higher cost of purchase and installation of these meters has been delayed until Q1 and Q2, 2014. These costs will likely significantly exceed the $150.08 average cost per meter projected for the remaining Phase I meter installations. This represents a likely potential cost exposure of several million dollars to account for the more expensive meters and additional installation labour.

It should be noted that the actual cost of performing inside meter completions, including the cost of scheduling appointments and taking other measures to gain access, has not been provided by HQ, even though it acknowledges that the installations completed by HQ are more complex and take more time.[22] And as mentioned above, the cost information involving the purchase of Elster commercial and polyphase meters has not been provided, so more precise calculations cannot be made.

HQ has estimated that in addition to 125-150 Capgemini meter installers, approximately 100 HQ installers will be required for Phase II, which confirms to us that a significant amount of effort to install the commercial, polyphase and inside residential meters must be provided by HQ personnel.[23] Based on the completion rates identified in the Phase II and III Authorization Request,[24] approximately 136 Capgemini installers would be required to complete the 663,000 remaining (2014) Phase I installations by June 30, 2014. This makes the unlikely assumption that Capgemini installers will continue to install 40 meters per workday even as the more difficult installations are left until the end (including the difficult inside access meters requiring multiple visits to complete).

## 3.2 Network Installation Progress

Hydro-Quebec has been continuing with the installation of Gridstream network collectors for Phase I of the LAD Project, and in connection with its R-3863-2013 filing, has been given authorization by the Board to proceed with the installation of additional collectors that will be used for Phases II and III. This effort has continued even though several technology changes have occurred since Phase I authorization was granted that could have potential consequences for the overall performance and cost of the project:

1. HQ has revised its plans to use satellite communications in favor of an increased number of cellular connections and collectors. This decision could have a significant impact on network

22 See response to Question 2.1, R-3863-2013, B-0026-DDR.

23 See response to Question 4.3, R-3863-2013, B-0026-DDR.

24 HQ states that the service provider (Capgemini) is averaging nearly 40 meters per installer per day, and HQ personnel are averaging 30 meters per day. See HQD-1, Doc 1, Section 3.1 dated Oct. 28, 2013.

performance and cost if sufficient bandwidth and required latency (network communications speed) cannot be achieved in remote areas without use of satellite connections.

2. HQ has discontinued its plans for a pilot WiMAX project, and will apparently rely instead on mesh and cellular communications for all rural and remote areas of Phases II and III.[25] It appears from this reference that HQ had considered WiMAX as a potential solution to provide additional bandwidth and ensure adequate communications to the outskirts of its service area. If Rogers is unable to provide sufficient reliable cellular coverage in these remote areas, an overall degradation in network read performance could result.

3. In order to cope with the demands of achieving sufficient network communications in rural and remote areas of Phases II and III, HQ has decided to deploy a larger number of collectors, including the use of gap collectors, in these regions. Beyond incurring additional installation costs for the added collectors, it is doubtful that the effectiveness of this approach has been confirmed since HQ is just beginning to install network equipment in Phases II and III.

It should be noted that the large original quantity of 14,950 routers has not been reduced, even as the number of collectors has increased by over 20%, from 560 to 688 collectors.[26] In a revised response to Question 3.1, HQ stated that gap collectors cost less than the standard collectors, therefore no budget increase is anticipated. However, no actual pricing information has been provided, and without knowing the deployment methodology and proportion of gap vs. standard collectors that will be used, it is not possible for us to independently verify HQ's assertions concerning the negligible cost impact of this change.

### 3.2.1 Potential Cost Impact of Network Installation Issues

Because Landis+Gyr's network equipment pricing information has not been provided, it is not possible to precisely determine the cost effects of certain network deployment changes. However, from the deployment information provided, some reasonable conclusions can be drawn concerning the impact of these changes on the project cost:

- In testimony provided for the LAD Project, Phase I Authorization, HQ stated that a total of 182 collectors and 3,896 routers would be required for Phase I.[27] In its revised response to Question 3.1, HQ indicated that it had installed approximately 165 collectors and 2,300 routers by February 18, 2014 with approximately 1.2 million meters installed (approximately 71% of Phase I installations) through that period. Projecting this coverage to 100% completion suggests that as many as 234 collectors could be required for Phase I coverage alone (although a small number of these collectors may have been installed for Phase II upon recent Board authorization).

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[25] See Hydro-Quebec Document #13867421, Section F-2, "Supply Equipment For WiMAX Communications". This document describes the pilot requirements.

[26] See B-0004, HQD-1, Doc 1, Section 3.2, and revised answer to question 3.1.
[27] R-3770-2011, n.s. VOLUME 5, March 22, 2012, pg. 13.

- The Phase I network coverage experience to date represents an average of approximately 7,300 clients per collector in the dense areas of Montreal and suburbs, and suggests that HQ may have significantly underestimated the total number of collectors that could be needed to obtain coverage for the entire project. Using HQ's original estimate of 560 collectors for the complete LAD project, it appears that over 40% of this projected quantity will be needed for Phase I alone, which, again, is the area with the highest client density.

- It is therefore quite likely, given the more expansive rural and remote areas to be covered in Phases II and III, that proportionately more collectors will be needed to cover the large areas. If a figure of 3,650 clients per collector is used for Phases II and III (assuming half the density of Montreal and suburbs), then it can be reasonably projected that an additional 575 collectors could be required based on the Phase I experience, producing a total project estimate of nearly 800 collectors needed to obtain the required read performance.

- HQ also reported that 2,300 routers were required to support communications for the first 1.2 million clients in the more dense areas of Montreal and suburbs. In the rural and remote areas of Phases II and III, it is likely that a substantial number of routers will be needed to augment the meter-to-meter mesh communications. Projecting coverage for the less dense rural and remote client densities in Phases II and III, an estimated total of 12-14,000 routers could be required, which seems consistent with the current contract number of 14,950 routers that will be provided by Landis+Gyr.

In testimony provided in connection with Phase I of the LAD Project, HQ stated that it has a contractual ceiling for the number of routers required, but it would need to pay more if additional collectors are required.[28] Given the potential for needing additional collectors as explained above, and the fact that HQ must pay for any additional collectors (recognizing that gap collectors are cheaper to purchase), it is reasonable to assume that HQ may be forced to incur additional costs to purchase and install additional collectors for Phases II and III.

It should also be noted that HQ acknowledged when applying for Phase I authorization that it had not completed the required Phase II and III propagation studies that must be completed to accurately determine the number of collectors and routers that would be needed for these phases. This has introduced a risk factor for network installation cost that in our view has not been satisfactorily considered or resolved.

## 3.3 Relationship Between Network Performance and Cost

As is the case with many other communications networks, a strong correlation exists between the cost of the network installation and the network's overall performance. The Landis+Gyr

[28] R-3770-2011 PANEL 6 - HQD May 25, 2012 Cross-Examination

Gridstream network is capable of supporting a number of important features that are beneficial to utilities such as improving electric service reliability and increasing customer service. Load management, distribution automation, outage management, volt/VAR control and other functionalities are examples of potentially available features and applications that go beyond reading meters and preparing a bill.

If not designed and built properly, the LAD Project's Gridstream network will not provide sufficient bandwidth and the optimum latency needed to support load control, remote capacitor control, outage detection and other utility applications that rely heavily on strong mesh communications and a reliable and timely link back to the MOC. Outage detection, for example, relies on receipt of last gasp alarms emitted by the meter and transmitted over the Gridstream network to reach HQ's systems in order to be effective.

An effective outage detection program would rely heavily on the Gridstream network to deliver a large percentage of these alarms to the MOC. If the number of data hops needed to transmit data through the mesh from meter to collector is too great, many of these alarms could be lost and the overall effectiveness of the outage detection feature will be compromised. Meters that have lost power cannot perform a relaying function, and a weak mesh design characterized by installation of too few collectors and routers will cause the outage function to become even more degraded and less reliable.

### 3.3.1 Bandwidth and Network Latency

In its report to the Board in May 2012,[29] HQ described some of these issues such as the effect that too many hops in the mesh network would have on network latency, which in turn will affect overall read performance and usefulness of other Gridstream applications such as implementing the remote disconnect function, performing on request meter reads, pinging the meter for power on status, and other advanced features. Other reasons such as transmission delay, caused by poor cellular connections and meter operations, were also correctly cited as reasons for unsatisfactory network latency. The report cited a worst case scenario of over 60 seconds for a fully deployed system's network latency, which is generally considered to be the upper time limit for satisfactory network performance.

The report also discussed network bandwidth and the associated capacity utilization rates for the collectors based on certain specified design parameters. However, it does not specify what applications (each transmitting data over the network) have been assumed in the bandwidth calculations so that the accumulation of all data traffic from all applications can be adequately considered. For example, if HQ elects to implement load management functions in addition to

[29] See HQD-8, Doc 1, Section 1 Telecommunications Performance dated May 2012.

advanced two-way Gridstream network functions such as the remote disconnect/reconnect function, performing commercial meter demand resets, pinging the meter, etc., the cumulative effect of this much data traffic could exceed the design capabilities of the Gridstream network and increase network latency beyond acceptable parameters. Many of these capabilities currently exist in the Gridstream network, but HQ has not discussed its plans to fully utilize all network features.

### 3.3.2 Why This is Important

Bandwidth and network latency are critical parameters for design of any communications network and must be specified at the design phase for the network to support the timely operation of network applications. These parameters are directly affected by the quantities of collectors and routers, and the quality and reliability of data backhaul over communications links such as cellular. If an insufficient number of collectors and routers is installed in the rural and remote areas of Phases II and III, HQ will have difficulty achieving the timely and reliable communications necessary to effectively operate functions such as on demand reads and the remote disconnect function, and implement future applications such as power outage detection.

Therefore, the actual required number of collectors and routers needed to support the Phase II and III mesh communications with the meters cannot be fully confirmed until Phase III is nearly complete and the network has been thoroughly tested with data traffic from normal operating conditions. If HQ has not estimated the projected collector quantities correctly, the network will have difficulty operating below the maximum 60 second response time that is generally considered the maximum acceptable latency for remote locations on the network. As a result, additional collectors and cellular links could be required at additional cost.

### 3.3.3 Meter Reading Performance

Perhaps the most basic but important function of the LAD network is to reliably and accurately read meters for client billing in order to permit the reductions in HQ personnel that are needed to achieve a significant amount of HQ's projected $81 million annual operating savings. HQ has established a daily meter read performance standard of 99.4%, meaning that each day the Gridstream network must read 99.4% of all new generation meters covered by the network.

In its February 14th report to the Board, HQ stated that the daily read rate is approaching 100%.[30] Valutech is concerned that this figure may mislead the Board because it represents a read rate taken from an unknown number of clients located in the more dense and easier to read client areas of Montreal and suburbs. As HQ begins to deploy the Gridstream network in the rural and remote areas of Phases II and III, it is likely that the read performance will diminish as the client

[30] HQD-3, Doc 1 dated February 14, 2014.

density and area topography become less favorable, and the number of clients per collector decreases. It is important that HQ verify that the 99.4% read performance is achieved at the end of Phase I before moving to the less dense areas of Phase II and III.

If daily read performance is not adequate, HQ may be forced to add additional collectors and routers in poorly performing areas to improve the daily read rate and achieve the 99.4% system wide read performance requirement. This problem could be further complicated by HQ's lack of experience with the new Elster residential meters that are expected to be purchased and installed in significant quantities for Phases II and III. If network performance problems with the Elster meter develop, HQ may be forced to choose between compromising network read performance or adding network equipment, which could increase project cost.

We understand that the new Elster meter must be programmed to communicate over the Gridstream network before shipping, and we do not believe that this has been done previously for any other North American utility. It is therefore not likely that the Elster meter has been sufficiently tested to verify acceptable read performance and reliable integration with the Gridstream mesh network, especially in less dense client locations similar to the rural areas of Phase III.

**3.3.4 Remote Disconnect Function**

In response to a question, HQ replied that it had tested the remote disconnect function and it had operated successfully in 142 different cases involving vacant premises.[31] Based on this small sample, this testing more likely constitutes what the industry calls unit testing to prove functionality, and does not provide required full system information on the latency of the disconnect/reconnect operations, or indicate whether disconnect and reconnect acknowledgements and time stamps were received. Since Phase I is not yet complete, and represents only 45% of all meters, we don't believe that HQ has adequately tested this function on a large scale using remotely located clients over a fully operational mesh network. Under these full operating conditions, the 60 second latency standard should not be exceeded for meters located in remote locations, or additional collectors and/or routers may be need to be added at additional cost.

The remote disconnect/reconnect function is highlighted here because HQ has cited it as a major benefit and source of much of the efficiency savings that will be achieved from completion of the LAD Project. If the network design is not sufficiently robust, and if disconnect latency is too long, then the potential benefit of implementing the remote disconnect function for the remote areas, and the projected operating savings that could be achieved, could be compromised.

[31] See response to a question from HQD-3, Doc 2, Response to Commitment #2.

So network performance, as determined by the effectiveness and timeliness of network applications, and measured using the parameters of bandwidth and application latency, will significantly affect the overall benefits, both current and future, that can be achieved through LAD project implementation. If the Gridstream network design is inadequate in these areas, additional equipment may be need to be purchased from Landis+Gyr at additional cost, or HQ may not be able to achieve much of the expected $81 million annual operating savings projected in its Phase II and III Authorization Request.

## 3.4 Problem Areas For Phase I Cost Overruns

As discussed above, a number of Phase I deployment issues exist that could have a significant potential negative impact on the Phase I schedule and cost. As more generally described in the sections above, we believe that the following specific areas provide the greatest risk to achieving Phase I completion within the authorized project cost:

### 3.4.1 Residential Meter Installations

HQ's December 31, 2013 Progress Report states that Capgemini has installed an average of 30,000 meters per week in Q4, 2013 (150 installers at 40 completions per day). It is doubtful that this weekly pace can be maintained in suburban areas and during the winter months without adding more personnel at additional cost, and it is not known how many of the Q4 2013 completions were for inside meters that take more time to complete. Based on a June 30, 2014 Phase I end date, Capgemini would need to maintain a constant pace of over 27,000 residential meters per week through June 30 even though many of the problem access meters are typically left until the end.

### 3.4.2 Inside Meter Issues

We know that nearly 70% of Phase I meters, or approximately 1.1 million meters, are located inside buildings and require a more lengthy and involved process to complete. As discussed earlier, Capgemini must install a minimum of 94%, or approximately 1.6 million of the meters in Phase I, which represents a potential exposure of 100,000 meters that HQ could be forced to complete with its own personnel. HQ as stated that 100 employees are required to install meters (See section 3.1.2) in addition to the Capgemini installers. This number presumably also includes resources to install the more complex commercial and polyphase meters, in additional to completing the most problematic inside meters that Capgemini has given back to HQ to complete. It is not known how many HQ installers were included in the original Phase I budget authorized by the Board, but it seems unlikely that these installations can be completed by June 30 unless HQ adds additional installers at additional cost.

### 3.4.3 Commercial and Polyphase Meters

In Section 3.3.1 above, we discussed the problem of commercial and polyphase meters, the delay in receiving MC approval for the Elster polyphase meters and the likelihood that these meters would cost more to purchase and install. As shown in Table 1 above, HQ has budgeted only $150.08 to install the remaining 663,000 meters in 2014. Since a majority of the 120,000 total polyphase meters are located in the Phase I area, these much more expensive meters will cost significantly more than $150.08 to purchase and install. HQ has not committed to installing the Phase I commercial and polyphase meters by June 30, and as mentioned above, this represents a considerable cost that could be deferred until after Phase II and III authorization is received.

### 3.4.4 Gridstream Network Equipment

HQ has been proceeding with deployment of collectors and routers in Phase I, and has made several technology changes such as using less expensive gap collectors that could provide a potentially more effective deployment option. However, the network installation progress to date suggests that a significantly higher number of collectors may be required overall to achieve adequate network coverage throughout the Phase I, II and III deployment areas.

As discussed in Section 3.2 above, HQ had previously estimated that 182 collectors would be required to provide complete Phase I coverage, and that 165 collectors had been installed as of February 2014 to provide coverage for approximately 1.2 million clients (71%) in Phase I. If the same proportion of collectors and clients is maintained (approximately 7,300 clients per collector), then it is likely that approximately 234 collectors will be required for all of Phase I, which would increase the network installation labour cost as well as the equipment cost, for this phase.

HQ has testified that it is responsible to pay for additional collectors purchased above the 560 total collectors provided in the Landis+Gyr contract. While this number is more than adequate for Phase I coverage, it suggests that higher than expected network equipment costs can be expected to appear later in Phases II and III. HQ in its Phase I filing stated that the 560 collectors were a reasonable number for the entire project, but as we have seen this number has already grown to 688 while HQ is still deploying collectors in Phase I.[32]

### 3.4.5 Rogers Communications

The intended use of gap collectors in addition to the higher capacity standard collectors for the LAD project suggests that the completed Phase II and III propagation studies have confirmed the existence of more difficult terrain in the rural and remote locations that can be better serviced through use of a greater number of collectors with less capacity. Without knowing the exact

[32] See R-3770-2011, B-0154, HQD-8, Doc. 1, pg. 5.

proportion of standard vs. gap collectors, it is possible that a larger total number of cellular connections could be required to set up and connect.

HQ stated in the Board's February 14th work session that although the exact commercial terms with Rogers are considered confidential, the Rogers contract is based on the amount of data transferred over the entire network rather than the actual number of connections. However, the amount of network data traffic is a function of many factors such as the meter read rate and size of data packets, extensive use of applications such as remote disconnect and on request reads, and other future applications such as outage detection and load management.

Without knowing the needs of future applications and fully understanding the requirements of the new business processes, it is often that case that the data transfer estimates are too low, and higher data tiers (and cellular cost) are found to be required later. It should be noted that telecommunications costs are one area of Operating Charges that has increased over the R-3770-2011 estimate ($3.7 million increase for Phase I).

**3.4.6 Impact of Scope Changes, Inefficiency and Delay**

Based on the information provided, it is difficult to assess the precise impact of project scope changes, inefficiencies and delays on the total project cost. This is especially true in areas where a portion of the cost is included within the HQ operating budget. A number of critical areas of project support such as HQ meter installation labour, installation of network equipment, project office, engineering, training, communications and IT support, are provided using HQ staff, and as a result don't receive the cost visibility that other project categories such as contracted services do.

Similarly, the projected HQ efficiency savings from areas such as meter reading labour are not easily quantifiable from the data provided, and delays in achieving operating efficiencies during the long deployment period can add to HQ's cost of deployment. Perhaps the single most important efficiency to be gained is the elimination of 726 HQ positions, including 603 meter reading positions, 102 positions for service cutoff and 21 customer service positions brought about by eliminating estimated bills. These staff reductions could have a significant positive impact on LAD project cost if the resulting labour savings were treated as a credit to the Operating Charges applied to the project cost during the deployment period.

According to its Third Quarter Report, HQ has saved $7.1 million by avoiding any reassignment costs through Q4 2013. Attrition and reassignments through 2013 have eliminated 126 meter readers, 29 shut-off employees and no customer service staff, for a total of 155 employees, or 21% of the projected total reductions. As mentioned, it appears that the reassignment costs ($31 million for total LAD project), *but not the associated labour cost savings*, are being allocated to the project.

Delays in implementing the remote disconnect function have reduced the amount of savings that can be achieved through elimination of the manual costs to disconnect, and the limited completion of inside meters requires that meter readers must continue to read these meters until the new generation meters are installed, which reduces the amount of labour savings that could occur during the period of project deployment.

And HQ has not made available some important cost information such as the cost of meters and collectors, the labour costs to read and install residential, commercial and polyphase meters, the cellular communications costs and the cost of system testing. If made available, this information could have been used to aid in the calculation of efficiency gains as well as projected project cost increases.

# 4.0 Phase II and III Cost Concerns and Risks

Upon review of the information provided by HQ in its Phase I Progress Report, Phase II and III Authorization Request and other responses, Valutech Solutions is concerned that some observed Phase I cost and deployment issues could begin to distort Phase I results and transfer some performance and cost problems to Phases II and III. This would have the effect of blurring or understating the final Phase I results and cost, and could also produce some unexpected increases in the cost of completing Phases II and III that could go undetected until near the end of the LAD project.

In Section 3 above, we discussed a number of areas of concern that could likely produce higher than expected Phase I costs, and could bring about limited or delayed benefits and future Gridstream network performance issues. If unresolved in Phase I, many of these issues could subsequently have performance or cost related impacts on LAD deployment in Phases II and III. In some cases, HQ could be required to address some tradeoffs between network performance and increased project cost.

Since the Board is being asked to authorize HQ to proceed with Phases II and III, it must first have a good understanding of Phase I progress and cost performance to date, and of the remaining Phase I work and cost expectations for completion over the next few months. We don't believe that the HQ Quarterly Progress Reports provide sufficient detail and visibility in all aspects of project activity that is needed to provide sufficient confidence to the Board that Phase I will be completed on schedule and at approved cost.

In the February 14th Board sponsored work session, HQ was unable to provide answers to some key questions, or to communicate a strategy and provide a written completion plan for completion of all Phase I activities by June 30, 2014. No information was provided concerning any plan to complete Phase I polyphase meter installations or complete the large number of inside meters located in Montreal and suburbs. The remote disconnect function, which was scheduled for implementation by the end of 2013, had not yet been implemented as of the time of this report. And no clear contingency plan was articulated in the event that Measurement Canada approval for the Elster polyphase meters is further delayed.

The proportionately higher than anticipated number of collectors installed in Phase I to date suggests that the total number of collectors needed for all phases could be significantly higher than was originally forecasted. A revised final number of collectors and routers needed for all phases should be re-forecasted and submitted to the Board prior to Phase II and III approval.

And the Phase I read performance, bandwidth and latency have not been sufficiently tested under full deployment and normal operating conditions. HQ should confirm the design standards that have been used, including verifying the required read performance and latency for clients located in all project phases including the remote areas of Quebec.

These and other issues raise our level of concern that HQ will not be able to complete all Phase I work by June 30, and that the final Phase I cost will not be known before Phase II and III authorization is approved. It is also a concern that some of the Phase I costs will be transferred to Phases II and III. A final Phase I completion plan should be provided to the Board that shows the planned completion of Phase I residential, commercial and polyphase meters and remaining network installations by June 30 to ensure that these costs will not be transferred.

## 4.1 Meter Installation Issues

Several sections of this report have described the circumstances related to installation of the new generation meters at locations where the meters are located inside the building. HQ has reported that Capgemini's obligation for completion of meter installations ranges between 94-98% of all meters, and Capgemini is required to achieve a maximum of 3.1 - 3.25 million meters out of 3.4 million meters for Phases I and II. This leaves as many as 150-300,000 meters, including mostly the more difficult inside and polyphase meters, for HQ personnel to install.

In addition to the above, HQ has stated that all 400,000 Phase III meters will be installed by HQ personnel.[33] If the minimum 94% expectation is achieved by Capgemini, then HQ could be required to install as many as 700,000 total meters with internal HQ staff. It does not seem likely that this number could be achieved without a significant increase in the number of HQ personnel assigned to the LAD project at additional cost.

[33] See HQD-1, Doc 1, Section 6.1 dated October 28, 2013.

## 4.2 Phase II & III Network Deployment

In its request for priority approval of Phase II and III network installations, HQ discussed a plan to continue deploying the Gridstream network in advance of Phase II and III authorization. HQ explained that for efficiency purposes and to prepare for Phase II meter installations the network deployment must actually go beyond the borders of the Phase I area. While there may be some minor technical benefits to this approach, it increases the difficulty associated with reconciling the completed Phase I deployment effort with the actual Phase I cost.

Phase II and III network deployment will be, by virtue of the topography and lower client density, much more difficult to complete. Network communications will become much more of a challenge as the client density diminishes and the mesh network requires a greater number of collectors and routers to perform adequately. HQ has stated that the expected meter read rate for billing purposes is 99.9%.[34] However, it does not appear that Landis+Gyr must meet this standard for Phases II and III within its current contract, since HQ will pay for any increases in the required number of collectors.

HQ has already announced that an increase in the number of collectors is recognized from the original quantity of 560 to a currently revised total of 688 which includes an unknown number of the cheaper gap collectors. However, as discussed in Section 3.2.1 above, if an average of 3,650 clients per collector is achieved in the Phase II and III deployment areas, which is half of the 7,300 clients per collector found in the more dense Phase I deployments through February 2014, one can project that a total of nearly 800 collectors for all phases of the project would be required.

## 4.3 Phase II and III Meter Requirements

In its request for Phase II and III authorization, HQ indicated that 20% of all meters (760,000) would be provided by Elster as a second source. The Elster residential meter must be programmed to work over the Landis+Gyr Gridstream network and should be expected to provide the same level of functionality. Since HQ considers meter pricing to be confidential, it is not known how the cost of the new Elster meter compares with the Landis+Gyr new generation meter. This pricing information should be available to the Board staff for review.

While it appears that the Elster residential meter to be used for this project has been approved by Measurement Canada, there is no evidence that it has been fully tested and deployed anywhere in North America. Use of this meter in such large quantities for the first time in a large utility operating environment raises some concerns that significant disruptions in the deployment

[34] HQD-8, Doc 1, Section 3 dated May 2012.

schedule could occur if a software bug or design problem is detected either before or after large shipments of the new Elster meters are received.

In addition, it is often the case that first run meters have a higher than expected failure rate as early production quantities begin to operate in a utility environment under real world conditions. If this should happen and Elster detects a manufacturing problem that affects deliveries or produces a recall of previous shipments, progress could be further delayed with a resulting costly impact on Capgemini and HQ's installation efforts.

Based on the Phase II and III installation schedule provided by HQ as Figure 2 in its authorization request, a worst case scenario would require that Elster must begin shipping meters by mid-2015. If this were to occur, the Elster meters would be almost entirely back end scheduled so that Phase II meters scheduled for Q4 2015 and beyond, and all Phase III meters, would be comprised almost entirely of the 760,000 new Elster meters. It is not known whether Landis+Gyr will warrant the reliable performance of the Elster meters over its network, and if read performance issues should result who would be responsible.

Valutech Solutions is concerned that Elster might not be able to supply these meters on time, and that any manufacturing production problems could disrupt the Phase II and III deployment schedule. Replacing them with additional Landis+Gyr meters might not be a short term option, and could add significant additional cost if Landis+Gyr is requested to provide additional meters on an expedited basis. HQ has not articulated any type of contingency plan to address this issue if the Elster meters are not available, and does not include this possibility among the project risk factors in its Phases II and III Authorization Request.

#### 4.3.1 Commercial and Polyphase Meters

As discussed previously, an estimated 120,000 or more new Elster polyphase meters must be installed in all phases of the LAD project, and a significant number of these meters are located in Montreal and suburbs in the Phase I deployment area. Since Measurement Canada approval has not yet been received for the new version Elster polyphase meter to be used for the LAD project, it is not likely that Phase I installations can be completed by June 30, 2014. HQ has not provided a schedule for installation of these meters, which involve HQ personnel and require more time and skills to install.

Valutech Solutions is concerned that installation of these polyphase meters could be delayed until after Phase II and III authorization is provided. In that event, the labour and material costs for these installations could increase the cost of Phases II and III, and would not be properly accounted for in the final Phase I cost before Phase II and III authorization is granted. In addition, HQ would not be able to adequately test them under Gridstream network operations and integrate them with EnergyICT and SAP before then. Current polyphase meters are being read through an Itron MV-90 system that will be eliminated once all commercial and polyphase clients are transitioned over to the Gridstream network. HQ will likely continue to pay for MV-90 maintenance and support costs until the MV-90 system has been completely eliminated.

## 4.4 Technology Risk Vs. Efficiency Gains

In its Phase II and III Authorization Request, HQ cited efficiency gains as a major justification for completing the LAD project.[35] Among the major areas cited for efficiency gains were the elimination of manual meter reading functions, manual power shut-offs and billing inquiries resulting from estimated bills. If fully realized, HQ states that these and other gains would produce annual recurring savings of $81 million beginning in 2018.

HQ has not provided detailed calculations to support its assertion that 726 positions will actually be eliminated through completion of the LAD project. The proposed breakdown of these positions is claimed to be 603 meter readers, 102 service technicians performing power shut-offs and 21 customer service positions handling billing inquiries. It can be assumed that the total position savings will be generated only through optimum performance of the Gridstream network.

If the performance standards outlined in HQ's Phase II and III Authorization Request and May 2012 presentation are assumed to apply, then we can expect that the following performance levels were used in calculating the efficiency gains:

- ***Daily Read Performance: 99.4%***
- ***Billing Read Performance: 99.9%***
- ***Remote Connection/Disconnection Rate: 98%***
- ***Customer Inquiries From Estimated Bill: Near 0%***

Given the risks associated with deployment of new technology in the remote and challenging areas of Hydro-Quebec's service area, and the Phase I results reported to date, we are not confident that HQ will sufficiently achieve these performance levels in all areas, particularly in the more challenging areas of Phase III. In the short time since Phase I was approved, HQ has already modified the LAD Project solution by no longer pursuing a WiMAX pilot, eliminated satellite connections and added the use of new Landis+Gyr gap collectors. HQ appears to assume that the Gridstream network can reach 100% of all rural and remote clients with the cellular collectors and mesh RF network.

These actions suggest that HQ has been attempting to find better solutions to improve the network's overall performance, particularly in the dense metropolitan area of Montreal (WiMAX) and in the rural areas by adding increased numbers of gap collectors. We are concerned that inadequate coverage and read performance could lead to a reduction in efficiency gains.

[35] HQD-1, Doc 1, Section 7.1 dated Oct. 28, 2013.

### 4.4.1 Billing Read Performance

We have previously discussed our concerns over the ability of the Gridstream network to read meters at a 99.9% read rate for billing purposes. HQ has cited the elimination of estimated bills as a key benefit of LAD implementation, and any type of reduced or impaired network performance could potentially increase the number of estimated bills or "pick-up" reads that would be needed. This technology risk is increased if HQ proceeds with Phases II and III without first achieving the 99.9% read rate in Phase I.

HQ has also stated that they would like to move to monthly billing in order to reduce the number of billing inquiries and provide clients with more information about their bill.[36] It is not clear if the efficiencies provided by the planned reduction of 603 meter readers can be achieved and still provide monthly billing if the Gridstream network cannot perform at a 99.9% billing read rate.

### 4.4.2 Elster Meter Risk

As mentioned previously, the Elster technology must work seamlessly with the Landis+Gyr meters and Gridstream network in order to operate efficiently over the network. If Elster's meter mesh communications is found to perform inadequately when integrated with the Landis+Gyr meters that are already deployed, then the combined Landis+Gyr/Elster solution might not be sufficiently reliable and robust to deliver billing reads at the required 99.9% performance level.

Remedial measures would then be needed to improve network performance, or the number of estimated bills would increase. In this case, HQ would likely need to retain a residual number of meter readers to obtain "pick-up" reads that were being missed by the network. The options at that point would therefore be to either upgrade the network at increased cost, replace meters, or reduce the efficiencies and benefits that could be expected.

### 4.4.3 Remote Disconnect Risk

HQ has verified performance of the remote disconnect and reconnect function by citing a proof of concept trial at Oncor in Texas that was 98% successful on the first attempt. Then, further tests were performed by HQ in a pilot controlled environment involving 142 meter operations. However, the HQ pilot was not performed during normal operating conditions, and neither the Oncor nor HQ trials involved use of the Elster meters that will be deployed in the rural and remote areas of Phases II and III, where network communications will be the most challenging. Significant risk could be introduced by purchasing and deploying the Elster meters before substantial testing has been performed over the Landis+Gyr network.

[36] HQD-2, Doc 1, Question 13.1, dated September 9, 2011.

Valutech Solutions is concerned that delays in implementing the remote disconnect function may be caused by integration problems with Gridstream, EnergyICT and SAP, and the reported testing has been very limited. The reasons cited by HQ for delayed implementation are not found to be persuasive, and this integration has not been completed and thoroughly field tested for the Elster meters that will be deployed in large numbers in Phases II and III. Consequently, the delayed implementation of this technology brings with it a level of technology risk that warrants taking a cautious approach to the elimination of the 102 service technicians performing manual shut-offs.

**4.4.4 Rogers Communications Risk**

Initially, HQ planned to use satellite communications to communicate with collectors located in rural and remote locations of the service area. In its recent filing for Phase II and III authorization, HQ stated it has now replaced the expected satellite links with additional cellular connections. Since network performance and delivery of the required benefits and efficiencies is significantly dependent on reliable and fast transmission links,[37] abundant cellular coverage will be essential to support reliable communications in the rural and remote areas of Quebec.

It is not clear why HQ now feels confident using 100% cellular coverage when this was not the case at the time of the Phase I filing. Deploying collectors with cellular modems or cards installed at the factory would most likely prevent a future transfer to satellite communications if the cellular coverage proves to be inadequate. Consequently, this approach adds to the technology risk of obtaining reliable communications in Phases II and III, and the expected labour efficiency gains would be reduced if manual meter readers were needed to obtain missed reads in remote areas.

**4.4.5 Other Efficiency Gains**

In its response to a question on efficiency gains,[38] HQ has restated that it will achieve 20 year efficiencies of $200 million, and annual efficiency gains of $81 million beginning in 2018. In describing these gains, HQ stated the following:

"These gains are made in 83% of those from the activity reports and 17% other activities or recovery (13%), customer activity (3%) and compliance (1%). These gains resulted primarily from a mass reduction in salaries."

From the limited information provided, we cannot verify the assumptions made or validate the calculations that produced these percentage reductions. Clearly, a significant basis for the justification of the LAD project comes about from a reliance on efficiency gains. Valutech

[37] See HQD-8, Doc 1, Section 1, RF Network Latency dated May 2012.

[38] D-2012-127 (R-3770-2011), paragraph 44.

Solutions suggests that the Board ask HQ to submit the details of these calculations and validate the results for Phase I before authorizing HQ to proceed with Phases II and III.

## 5.0 General Conclusions

Valutech Solutions has completed a review of available material for this file including HQ's responses to Board and intervener questions. We also participated in the February 14, 2014 work session established by the Board to discuss the issues related to Phase I that could affect the total LAD project cost. Given the Board's mandate to focus on Phase I performance and cost, and potential Phase II and III cost issues and risk factors, we have attempted to evaluate the information provided in this case and determine what conclusions can be drawn that will assist the Board in making its decision whether and when to provide Phase II and III authorization.

It is evident from HQ's Authorization Request and its December 31, 2013 Quarterly Progress Report that significant progress has been made towards completion of Phase I meter and network installations. HQ has reported that a substantial portion of the Phase I Gridstream network has been deployed, and that nearly 1.2 million meters have been installed as of February 2014. However, some important work remains to be done if HQ is to begin realizing the benefits of the large investment involved, and the Board must decide at what point sufficient benefits have been demonstrated to justify the additional cost of going forward with Phases II and III.

In this report we have described the Board's mandate and our basis for intervention. We have attempted to independently assess progress, and to identify the major risk factors that could produce increases in project cost and limit network performance and expected efficiency gains. Given our knowledge of AMI systems, we have attempted to perform an independent analysis of the ongoing deployment issues and provide a basis and rationale for our general conclusions and recommendations.

To that end, Valutech Solutions has reached the following conclusions:

- HQ has not demonstrated that Phase I deployment progress and network performance are sufficient to warrant unconditioned authorization to proceed with Phases II and III. The installation of meters and network devices are not by themselves an adequate metric to persuade us that the LAD project will be completed on time, within the budget and will provide the required benefits and efficiency gains.

- The continued existence of some risk factors raises concerns that moving ahead too quickly could be counterproductive and costly. Unexpected delays in receiving Elster meters, for example, could adversely impact HQ and Capgemini installation efforts and drive up cost. Some technical questions exist that could delay or increase the project completion cost if not resolved in a timely manner. Measurement Canada approval of polyphase meters and Elster residential meter availability and performance are examples of obstacles that could produce costly delays.

- Gridstream network read performance has not been sufficiently validated over the substantially completed Phase I deployment area under normal utility operating conditions. Other than in specific pilot areas, HQ has not provided evidence that a 99.9% billing read rate can be sustained during peak network data traffic and operating conditions. If this percentage cannot be consistently achieved in Phase I, then it is likely that the read rate percentage for the less dense rural and remote areas of Phases II and III will be even more problematic.

- The remote disconnect and reconnect function has not been adequately tested. A small 142 meter unit test of the remote disconnect function does not represent a statistically significant sample for a much larger meter population to test the operation latency under widespread use and normal operating conditions. A significant risk factor is the potential use of this function for the 760,000 Elster residential meters that will populate the outlying areas but have not been tested over Gridstream.

- Of the three major benefits categories (billing and daily read rate, remote disconnect and eliminate estimated bills), none has been sufficiently verified in Phase I to warrant moving to Phases II and III. Efficiencies to be gained from the LAD project will mostly come from a reduction in staff positions due to implementation of these functions and benefits. If network performance in these critical areas proves to be inadequate, then fewer positions can be eliminated and the expected efficiencies will not be realized.

- HQ has not adequately reported the status and cost of inside meter completions in Phase I. Given the Capgemini performance metrics discussed in this report, it is likely that many of the remaining 500,000 meters to be completed in Phase I are for the difficult to access meters that will be returned to HQ to complete. A significant concern is that Phase I meter installation costs will increase in the final months as HQ directs more resources to this area.

- In addition to completing the more difficult Phase I and II inside meters, HQ is responsible for installing the 400,000 new generation meters in Phase III. It is not clear that HQ has adequately included the cost to change out these meters in its Phase II and III Authorization Request. More visibility is needed to capture HQ's meter installation costs and determine if this effort is adequately funded in the projected budget for Phase III.

- The sensitivity analysis provided by HQ in its Phase II and III Authorization Request is not sufficiently rigorous, and does not include the risks associated with external issues such as receiving Measurement Canada approval, Elster residential meter delivery and performance issues, Rogers Communications coverage gaps and network read performance deficiencies. The integration of Landis+Gyr and Elster technologies over one network could create some network performance risks that have not been sufficiently considered. Network performance issues could directly compromise expected efficiency gains.

- Bandwidth and latency requirements do not appear to be adequately considered as key metrics for full network performance. Some discussion of these issues was provided in HQ's May 2012 presentation, but no risk analysis or corrective action planning is evident for the event that network transmission is deficient. HQ could be forced into higher costs if Phase II and III bandwidth and transmission speed are found to be substandard.

- HQ's Phase I authorization request based the Gridstream network design on a "proof of concept" approach, and Phase II and III propagation studies had not been completed at the time of authorization. It does not appear that Landis+Gyr analyzed the network data traffic under different operating scenarios to calculate Phase III latency and the maximum number of mesh hops (which effects the number of collectors needed). The addition of data traffic from future applications such as outage detection and load management could degrade network performance below acceptable levels if sufficient bandwidth is not provided.

- The amount of detail provided in HQ's Phase I reporting is not adequate for proper oversight of a project this size. HQ's Quarterly Reports show progress at too high a level to be effective for identification of problems and monitoring and project control purposes. Key statistics such as the number of inside meters completed, the number of Capgemini turn backs, the number of collectors, routers, commercial and polyphase meters installed are not being reported against the plan. The number of clients billed using data from the network vs. the total number of bills issued is another important statistic that is not being reported. Potential for project cost overruns cannot be adequately assessed from the progress and status information contained in these reports.

- Progress towards efficiency gains is not being adequately reported. At this point, staff reductions are occurring as employees are moved to other positions. Greater visibility is needed to translate staff reductions into eliminated positions and actual dollars saved. HQ's staff reductions against the plan and the dollars saved should be reported each quarter. The network read rate, estimated reads and remote disconnect savings should be reported each quarter to confirm that real progress is being achieved towards meeting the $81 million projected annual efficiency gains.

## 5.1 Summary of Conclusions

Given the above conclusions, Valutech Solutions believes that some significant hurdles still exist that could cause HQ to exceed its budget projections or be forced to accept a potential reduction in network performance and efficiency gains. Several important technology risk factors exist that could limit network performance or require costly and time sensitive alternatives to overcome. It is also likely that network equipment and meter installation costs will prove to be higher than expected, although under current deployment and reporting methods the additional costs may not be detected until much later in the Phase II and III deployment schedule.

The Elster residential meters to be used for 20% of HQ's clients must be programmed for use on the Gridstream network, and have not to our knowledge been fully tested and deployed anywhere in North America. This represents a significant technology risk that shipments could be delayed or network performance might not be adequate once they are installed. Problems discovered with programming and integration of these meters into the Gridstream network could produce unforeseen consequences that are costly to overcome. None of these Elster meters would be deployed until after Phase II and III authorization is granted, and we see no contingency planning for the event that alternative meters must eventually be used.

Measurement Canada approval for Elster's new version polyphase meters has not been granted as of the date of this report, and represents another technology risk which could potentially affect thousands of HQ's largest clients. HQ's MV-90 system must remain operating until the new meters are installed, which adds to operating cost and reduces efficiency gains. And it is therefore not likely that HQ has tested the new version polyphase meters over Gridstream. The cost of installing these meters may not be reflected in the final Phase I cost if installation is pushed into Phases II and III.

Neither HQ nor Landis+Gyr have provided evidence that a rigorous full system analysis of bandwidth and latency expectations has been performed, which increases the risk that network data transmission will be slow and will require costly upgrades to remedy. Network propagation studies, while considered an important step for initial estimation of the number of collectors and routers that will be needed, provides limited operational value since the positioning of routers is not included and the mesh network has not been deployed. If mesh communications or cellular coverage are found to be less reliable than initially estimated, especially in the rural and remote areas, then HQ may be required to add additional collectors at additional cost to purchase and install.

We are not satisfied with the lack of transparency and visibility provided by HQ in its project reporting mechanisms. Projects of this size require a much more rigorous commitment to project reporting, issues identification and reporting of corrective actions taken. The high level quarterly reports provided by HQ so far do not provide sufficient insight into the areas of greatest technology and cost risk.

From the information provided in the quarterly reports, it is not possible to fully assess ongoing network performance or project the amount of future cost overruns that could occur. While some discussion of staff reductions is provided, there is no translation of these reductions into actual dollar savings to demonstrate that the required efficiency gains are being achieved. Without adequate data capture and detailed reporting of the internal HQ costs to install network equipment including polyphase and residential inside meters, it is likely that some Phase I costs will be carried over to future project phases.

# 6.0 Recommendations

It is apparent from the conclusions outlined above that some significant cost and technology risks remain that could affect completion of Phase I deployment on time and within budget, and could also affect the successful and timely completion of Phases II and III. While HQ has made significant progress with the deployment of 162 collectors and 1.2 million meter installations as of February 2014, we believe the risk factors and areas of concern described in Section 5 above warrant some additional time and attention to resolve before moving ahead with Phase II and III authorization. Our specific recommendations are as follows:

1. HQ should first complete all Phase I work and provide the Board with a detailed accounting of performance and cost results before authorization is given to proceed with Phases II and III. We estimate that a six month extension until the end of 2014 should be sufficient to complete all Phase I network and meter installations and provide additional time to validate the overall network performance and cost.

2. HQ should submit a detailed Phase I Completion Plan and Schedule to the Board showing completion of all activities related to Phase I. Future Quarterly Progress Reports should measure progress against this plan. Collector, router and meter quantities, installation costs, the dollars spent and the benefits gained should be reported against the plan requirements.

3. The risks associated with Measurement Canada approval of polyphase meters and Elster residential meter performance should be resolved before HQ is permitted to proceed with Phase II and III deployment. These meters are critical to the successful performance of the Gridstream network, especially in Phase III which will consist almost entirely of the Elster meters. Meter performance issues could significantly increase deployment time and project cost if an alternative solution must be found.

4. Before moving to Phases II and III, HQ should verify that the completed Phase I network achieves the required daily and billing read rates, and that the bandwidth and latency characteristics are sufficient to support all utility operations. If remediation is required to improve network performance, any corrective actions should be identified and completed before Phase II and III deployments begin.

5. HQ should submit a more in-depth sensitivity analysis that includes the external threats to completion that have been identified in this report. In addition to identifying these risk factors, HQ should provide contingency plans to address the huge potential impact that external threats such as failure to obtain MC approval for polyphase meters, Elster residential meter and mesh network failures, Rogers cellular communications coverage gaps, etc. could have on project schedule and cost.

6. A significantly more robust testing of all parts of the remote disconnect and reconnect function is needed (operation, acknowledgements, time stamp, etc.). HQ should test a much greater number of both Landis+Gyr and Elster meters for successful disconnection and

reconnection of the meter from all areas of Quebec, including the rural and remote areas of Phase III, and verify that nearly 100% operation is achieved at a latency of less than 60 seconds.

7. The Board should request a much more detailed accounting of the installation of the polyphase and residential inside meter costs. HQ has not adequately reported the number of returns that are received from Capgemini, and the number and cost of internal HQ staff that is needed to complete these installations. These meter installations should be included as part of the Phase I Completion Plan and reported on with each quarterly report.

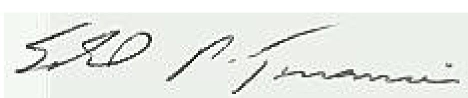
8. A more detailed calculation and accounting of the efficiencies gained should be included in the Phase I and future phase quarterly reports. HQ should monitor the staff reductions in all categories to verify that the positions have been eliminated and the dollars have been saved. A much more rigorous reporting effort is needed that clearly shows the progress being made towards the $81 million in annual savings claimed in justifying the LAD project.

9. HQ should submit a detailed Phase I Project Completion Report to the Board when Phase I is completed. This report should detail all actual project costs, identify the savings and efficiency gains incurred and address any network performance issues.

**Statement of Condition**

This report has been prepared by Valutech Solutions Inc. in connection with the aforementioned Filing R-3863-2013 dated October 28, 2013 by Hydro Quebec with the Quebec Energy Board and shall not be used for any other purpose. The expert opinions and recommendations contained herein reflect our professional views based on the available documentation in this case, and are subject to clarification or revision if additional material related to this proceeding becomes available.

Submitted By:



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March 11, 2014