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December 22, 2015

The Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director Corporate Services & Board Secretary

Dear Ms. Blundon:

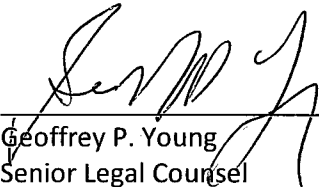
Re: Liberty Consulting Group Review - Event of March 4, 2015
Final Submission

Enclosed please find the original plus 12 copies of Newfoundland and Labrador Hydro's final submission in relation to the above-noted matter.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO



Geoffrey P. Young
Senior Legal Counsel

GPY/cp

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Thomas J. O'Reilly, QC – Cox & Palmer
ecc: Roberta Frampton Benefiel – Grand Riverkeeper Labrador

Thomas Johnson, QC – Consumer Advocate
Danny Dumaresque

**Review of the
Newfoundland & Labrador Hydro
March 4, 2015 Voltage Event**

Final Submission

December 2015



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1 **1. INTRODUCTION**

2 On October 22, 2015 the Liberty Consulting Group (“Liberty”) filed its report entitled Review of
3 the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse (“March 4 Report”)
4 with the Board of Commissioners of Public Utilities (“Board”).

5
6 Questions arose during the recent Prudence Review Hearing arising out of the March 4 Report.
7 In that regard, Mr. Henderson confirmed that improvement was required based on the lessons
8 learned from the March 4, 2015 events and that Hydro was committed to that improvement.¹

9
10 Subsequent to the Prudence Review Hearing, Hydro wrote to the Board on November 17, 2015
11 with respect to the March 4 Report and noted as follows:

12
13 “Hydro is taking Liberty’s report under advisement. Since March 4, 2015, Hydro
14 has changed how it responds to adverse events including how it dispatches and
15 runs generating plants. Hydro has also implemented improved internal and
16 external communication protocols to ensure its emergency response is robust.
17 These changes built on the significant work done following the January 2014
18 outage. The company will continue to move forward with its work to improve
19 reliability for customers.”

20
21 Following the March 4 events, Hydro provided a briefing update on March 10 (subsequently
22 updated to April 10) and a report on April 10, 2015 to the Board dealing with the March 4
23 events. Hydro also provided a response to follow-up Board questions on May 15, 2015, and a
24 Field Investigation Report for each of the Holyrood Combustion Turbine (“CT”) and Holyrood
25 Units 1 and 2 in relation to the March 4 events on July 10, 2015. Those materials provided the
26 background to the March 4 events as well as improvements taken or planned to be reviewed by
27 Hydro.

¹ October 29, 2015 Transcript, page 99, lines 3-6.

1 The remainder of these Closing Submissions will summarize the actions taken by Hydro in
2 response to the lessons learned from the March 4, 2015 events together with Hydro's
3 comments in reply to the recommendations by Liberty on page 9-10 of its March 4 Report.
4 Hydro is committed to reliable service for all its customers, in a safe and least cost manner.
5 Hydro believes the actions detailed in this submission, as well as comments in reply to Liberty's
6 recommendations demonstrate Hydro's commitment for reliable service to customers.

7

8 **2. ACTIONS TAKEN OR PLANNED TO BE TAKEN ARISING FROM THE**
9 **MARCH 4, 2015 EVENTS**

10 Following the March 4, 2015 events Hydro has undertaken the following specific actions:

11

12 1. The undervoltage protection settings for the Come By Chance capacitor banks
13 have been changed to a new setting of 16,000 cycles (4.4 minutes) at 50%
14 voltage to help ensure the capacitor banks do not trip for transient disturbances
15 or during steady-state operation where voltages are below acceptable limits.

16

17 2. Corrective action has been taken addressing the fuel control valve on the new
18 Holyrood CT as follows:

19 a. The valve set position corresponding to the required flow rate was
20 immediately marked on the valve so that if moved, the valve could be
21 quickly returned to the proper position;

22 b. The valve was locked in position using a temporary device so that it
23 could only be moved through the deliberate removal of this locking
24 device. An engineered permanent locking mechanism was procured,
25 received and will be installed when an appropriate window of time
26 presents itself. The temporary device is appropriate to remain in
27 place until the permanent device is installed; and

28 c. A pre-start-up verification of the valve position was instituted.

29

1 3. Hydro has expanded its previously occurring daily reviews and reporting of
2 capability and reserves to include a dedicated assessment of system conditions
3 on the Avalon Peninsula. System reliability assessments of both the Island
4 Interconnected System and the Avalon Peninsula are now performed daily,
5 based on current load forecasts for the next seven days. The assessments allow
6 for advance coordination of primary generation, standby generation, and
7 sources of reactive support, such as capacitor banks. The daily report is
8 prepared within Hydro’s System Operations department and the changes include
9 forecasts of the Avalon capability, the impact on the capability of the system in
10 the event of the largest single contingency, and the Avalon reserves for the
11 upcoming seven days. This report is used by Hydro’s Energy Control Centre
12 (“ECC”) operators to understand the Avalon capability with specified assets
13 available and under the single largest contingency. This Avalon report is also
14 reviewed at the morning system meeting, where any required notification of
15 alerts would also be discussed.

16
17 If the availability of assets on the Avalon changes, Hydro will perform reliability
18 assessments in order to determine the Avalon capability and reserves for each of
19 the upcoming seven days. If the reserves in any day are less than the impact on
20 the Avalon capability of the single largest contingency, plus an additional reserve
21 of 35 MW, Hydro will communicate with Newfoundland Power at regular
22 intervals until the Avalon reserves return to normal levels, i.e., above the
23 threshold that requires further notification. The status updates provided to
24 Newfoundland Power by Hydro have been revised to now include the Avalon
25 capability and reserves forecast.

26
27 These daily assessments are used in concert with the customer/stakeholder
28 communication protocols utilized by Hydro. Hydro has also updated its
29 notification protocols that result from system assessments to include the

1 notification of the Avalon capability and reserves to Newfoundland Power. This
2 is similar to what was already in place for the assessment and notification of
3 Island Interconnected System capability and reserves and is referred to as T-096
4 “Avalon Capability and Reserves.” This instruction was submitted to the Board
5 for information on October 14, 2015. The instruction was approved internally at
6 Hydro on June 26, 2015. Hydro notes since April 8, 2015, System Operations
7 have been generating the Avalon capability and reserves report and sharing with
8 Newfoundland Power.

9
10 4. Hydro worked with Newfoundland Power on the specification of an
11 undervoltage load shedding protection system for Newfoundland Power’s 66 kV
12 transmission system that will trip feeders when voltages drop below prescribed
13 thresholds. Such an automated scheme will help to ensure that the system
14 operates within specified voltage limits and will prevent the consequential
15 undesired tripping of generators. A basis of design for the undervoltage load
16 shedding was submitted to Newfoundland Power on June 30, 2015. A final
17 design was developed by Newfoundland Power and was accepted by Hydro on
18 November 5, 2015. The automated scheme was implemented by late November
19 2015.

20
21 5. Hydro reviewed the following protection operations which occurred on March 4,
22 2015:

- 23 a. the resultant trip of the Star Lake generating unit was evaluated to
24 determine if any changes were warranted to the protection systems
25 of that unit. It was determined that the unit tripped on
26 overfrequency, as is appropriate for the protection of this unit;
- 27 b. the resultant trip of Holyrood Unit 3 was reviewed and the protection
28 is confirmed to have operated as required; and

- 1 c. The protection operation trips of transmission line TL 208 and T2 at
2 the Vale (Long Harbour) Terminal Station were reviewed to
3 determine whether adjustments are necessary. Hydro staff (System
4 Operations and Protection and Control personnel) met with Vale staff
5 to review if any actions are required as follow up from the March 4
6 undervoltage event. The group determined that no action is required
7 and that protection operated as required.
8
- 9 6. The operating instructions relating to equipment ratings and bus limits were
10 reviewed with the ECC operators. The need for prompt and coordinated load
11 shedding (with Newfoundland Power) was emphasized to ensure that acceptable
12 delivery point bus voltages are maintained under equipment outage
13 contingencies.
14
- 15 7. Hydro reviewed its operating procedures and has commenced the practice of
16 operating standby generating units (that support the Avalon) in advance of the
17 single largest Avalon contingency, rather than starting them after the event has
18 occurred. To support this improvement, Hydro’s ECC operators are receiving
19 daily standby generation requirement guidelines for supporting the Avalon
20 transmission.
21
- 22 8. An Operator Training Simulator session was developed that simulates the events
23 of March 4. All of Hydro’s ECC operators participated in this simulator training
24 session, where they experienced declining voltages on the Avalon power system
25 and acted accordingly to stabilize and restore the system.
26
- 27 9. There is a process in place for Hydro to place a red alert banner on its main
28 webpage advising of a system event. Following the March 4 events, Hydro has
29 moved the banner to the center of the main webpage, immediately above the

1 main navigation icons. The red banner includes a link to information on the
2 Advance Notification Levels and effective ways to conserve electricity.

3
4 10. An additional communication feature has been added to the website, which
5 allows a pop-up display to take over the main page of the website, advising
6 customers of a power alert. This is an added feature to ensure anyone visiting
7 Hydro’s website is made aware of a power alert in effect.

8
9 11. The “Outages” button on the front page of Hydro’s website links to the
10 distribution customer Power Outage and Emergency System. The existing
11 system was developed for Hydro’s own distribution customers and is at end of
12 life. Hydro is currently testing the new customer facing web application which
13 includes an outage notification component. Post successful testing, the
14 application will be launched online.

15
16 12. The Joint Storm/Outage Communications Plan was developed with
17 Newfoundland Power following the January 2014 supply disruptions. It is to be
18 followed by both utilities during significant system events impacting both utilities
19 – i.e. major weather events, system disruptions or system supply shortfalls. The
20 plan outlines specific communication tactics, timelines, messaging, approval
21 requirements and stakeholders.

22
23 On March 4, 2015, all processes outlined in the plan were followed and timelines
24 were met. However, it has become increasingly apparent that customers and
25 other stakeholders expect information to be provided to them as quickly as
26 possible. Therefore, in an effort to get information out to customers more
27 expeditiously, the following changes have been made to the plan:

1 First, timelines have been adjusted as follows:
 2

Communication Tactic	Timeline in Original Plan	Revised Timeline
Initial social media acknowledgement	Within 30 minutes of a Level 2 or Level 3 event.	Within 15 minutes post a holding statement. Electricity System Notifications, customer requirements and critical information (i.e., conservation tactics) posted as soon as alert level confirmed.
Media holding statement	Within one hour of a Level 3 event, for Level 2 event use discretion.	Within 30 minutes for a Level 3 event brief holding statement information can be released. For Level 2, use discretion.
Website	No specific target identified	Within 15 minutes for a confirmed Level 2 or Level 3 event post a holding statement. Electricity System Notifications, customer requirements and critical information i.e. conservation tactics posted as soon as alert level confirmed.
Internal communication	Within one hour for a confirmed Level 2 or Level 3 event if required.	Within one hour for a confirmed Level 2 or Level 3 event if required.
Media release	Within 1.5 hours of mobilizing the communication team for a Level 3 event. For a Level 2 event, use discretion.	Within one hour of mobilizing the communication team for a Level 3 event. For a Level 2 event, use discretion.
Media conference (if required)	Before end of business day for a Level 3 event. Ideal timing however is prior to noon news (11:00 am) or early afternoon.	No Change.

Communication Tactic	Timeline in Original Plan	Revised Timeline
Formal updates for prolonged events (as required) <ul style="list-style-type: none"> - News releases, internal updates, media conferences, social media 	As new information comes in: <ul style="list-style-type: none"> - Media updates via interviews or media release as substantial information changes are required – use discretion. - Internal updates (as needed). - Social media/website (ongoing). 	No Change.
Stakeholder relations	Minimum twice daily, AM and PM.	No Change.

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Second, holding statements have been developed jointly with Newfoundland Power, which allow both utilities to post a high-level statement immediately – before all information and facts on the event are known. The approved holding statements are found as Appendix F in the updated plan. The jointly revised plan containing the above modifications was filed with the Board on November 30, 2015.

Hydro has also initiated an equipment advisory protocol. The Equipment Advisory Protocol was developed following the March 4 event and outlines both Corporate Communications and Systems Operations activities required during significant equipment outages – both generation and transmission related. The intent of issuing equipment advisories for major pieces of Island Interconnected System generation and transmission equipment is to both help customers have a better understanding of the electricity system and the work that happens on equipment, and to provide any important information when an equipment outage may increase system vulnerability. For example, in the event that an emergency repair is required on TL 202 (which is one of two lines servicing the

1 Avalon Peninsula) during February when load on the system is high – messaging
2 in the advisory would include information on how to prepare for and stay safe
3 during outages and when to expect additional updates.
4

5 13. Communications between Holyrood Operations and ECC Operations include the
6 most likely return to service time for equipment, as well as the range of return to
7 service times where such risk exists. This will enable greater awareness by the
8 ECC to prepare for potential reliability issues and potentially earlier alert
9 notifications for customer communications.
10

11 14. Follow up items from Hydro's field investigation on Unit 1's delayed return to
12 service and the Unit 3 trip are noted below. Hydro has implemented the
13 following improvements to operations at Holyrood:

- 14 a. Identified and corrected improvements to instrumentation that
15 caused issues during purging and re-gassing of all units. Also, purging
16 and re-gassing procedures have been reviewed with Operations.
- 17 b. The control power to electronic controls and the power to the
18 Variable Frequency Drive (VFD) cabinet cooling fans were supplied
19 from Station Service. This caused trips to the VFDs and subsequently
20 the generating units themselves whenever there was a bump on the
21 Station Service feed. During the 2015 maintenance season, the
22 control power was switched to a UPS, battery-backed power feed and
23 the power to the cooling fans was changed to unit service. These will
24 provide more reliable power to the VFD fans and increase unit
25 stability going forward.
- 26 c. With respect to the carbon dioxide required for generator purges,
27 Hydro investigated repairing the faulty existing carbon dioxide line, or
28 installing a new carbon dioxide line. Both options identified
29 significant cost items as well as work protection potentials that

1 restricted completing these activities in 2015. Instead, piping was
2 modified for all three units so that a skid of carbon dioxide can be
3 brought into the powerhouse and tied-in directly for generator
4 purges. The modifications included installing short sections of piping,
5 isolation valves and quick connect fittings beneath each generator to
6 allow easy connection of a portable carbon dioxide skid. This enabled
7 bypassing of the existing carbon dioxide supply line and permits fast
8 and efficient purging of the generator.
9

10 **3. HYDRO RESPONSE TO LIBERTY RECOMMENDATIONS**

11 On pages 9 and 10 of its March 4 Report, Liberty makes five recommendations. Each of these is
12 listed below with Hydro's response.

- 13
14 1. *Hydro should assign a team to implement a program to establish a more robust operational*
15 *philosophy regarding reliability.*

16 Hydro views service continuity as critical to its customers. Hydro evaluates its
17 performance with a goal of continuous improvement, and also reviews its
18 investments to continually improve its service continuity and reliability. Hydro
19 has enhanced its reliability foundations over the past number of years, through,
20 for example, intensive condition assessments, and those foundations were built
21 on through increased medium to long term capital investment planning.
22

23 This previously existing objective of service continuity was further enhanced
24 after the March 4, 2015 interruption. These enhancements are a further step
25 forward in Hydro's approach to maintaining a reliable system. This is especially
26 evidenced by the system and operational changes implemented in 2015 as
27 discussed above, such as the development of the Avalon reliability assessments
28 and procedures and placing standby generation online in advance of the single
29 largest contingency, as opposed to after the contingency occurs. This can result

1 in increased supply costs when operating the system, but results in lower risk of
2 customer impact and unserved energy in the event of a contingency.

3
4 Hydro will consider Liberty’s advice and recommendations in future planning as
5 it continues to build on the work completed in 2015 with respect to improved
6 reliability in planning for 2016 and beyond.

7
8 *2. Hydro should enhance the skills and capabilities it brings to reliability engineering and*
9 *analysis.*

10 Hydro notes that a number of the actions taken in 2015, and discussed
11 previously in this submission, have internally deepened the skills and capabilities
12 with respect to reliability engineering and analysis. An example of such an action
13 is that Hydro has become a member of the Centre for Energy Advancement
14 through Technological Innovation’s (CEATI’s) Power System Planning &
15 Operations program. The strategic direction of this program is summarized as
16 follows:

17 ...to enable the use of new technologies, including FACTS,
18 to enhance the use of existing and new transmission
19 facilities while continuing to maintain a high level of
20 reliability. This includes exploring and developing tools and
21 techniques for planning and operating transmission
22 systems in a reliable, secure and cost-effective manner.²

23
24 Hydro remains committed to the development of personnel and will continue to
25 look for opportunities for courses and training in the field of reliability. For
26 example, Hydro has recently moved an employee with load flow capability from

² <http://www.ceati.com/collaborative-programs/transmission-distribution/pspo-power-system-planning-operations/>

1 System Planning into System Operations on a rotational basis. This person was
2 replaced in System Planning with a new employee, thereby adding to the staff
3 complement involved in reliability analyses in System Planning and System
4 Operations.

5
6 With a continued focus on reliability, Hydro’s System Operations and System
7 Planning groups are developing initiatives that will ensure that system operators
8 have clear direction when faced with outages to major system elements. An
9 example of such an initiative involves developing a set of System Operating
10 Limits for outages to system elements including 230 kV transmission lines and
11 major generating units.

12
13 Hydro reiterates that a number of the actions taken and discussed in this
14 submission have the effect of improving reliability engineering and analysis, with
15 the most obvious example being the Avalon capability and reliability assessment
16 reports that are used by numerous staff to make decisions both from an
17 operational and communication perspective.

18
19 Hydro will consider Liberty’s advice and recommendations in future planning as
20 it continues to build on the work completed in prior to and in 2015 with respect
21 to reliability engineering and analysis and the associated skill set within the
22 Hydro team for 2016 and beyond.

- 23
24 3. *Hydro should take steps to ensure situational awareness among operators and others who*
25 *need the information to respond promptly and ably to adverse system conditions.*

26 Hydro has an extensive training program for its operators. This includes
27 scenarios, such as system restoration plans, or events that have occurred on the
28 system that operators should be exposed to in a simulated environment. These
29 planned training scenarios provide situations where the operators are required

1 to respond rapidly and competently. This program was in place prior to March 4,
2 2015. In addition to the existing training scenarios, as previously discussed,
3 Hydro developed a specific training session to simulate the rare undervoltage
4 event that occurred on March 4, 2015 and all operators have been through this
5 scenario.

6
7 In addition to the planned training scenarios, Hydro will communicate any
8 operational outcomes following any major system event. This would occur upon
9 conclusion of the review of the event. Employees would also be reminded to
10 respond quickly and with increased urgency.

11
12 Further, in the winter season, for each weekday, Hydro has embedded senior
13 technical System Operations personnel in the ECC in the morning period prior to
14 peak, as well as prior to evening peak, providing additional support and oversight
15 to operators. For weekends, Hydro assesses the system to determine if the
16 senior technical personnel are required in the ECC for morning and evening
17 peaks.

18
19 Hydro notes that the daily system meetings that occurred in the winter period of
20 2014-2015 (started in November 2014), in fact continued through spring,
21 summer and fall of 2015 with a heightened awareness of Avalon capability. The
22 meetings provide an opportunity to those managing and monitoring the whole
23 system to take action as required throughout the year should any issues develop
24 on the system.

25
26 Finally, Hydro has improved on several tools operators and others managing the
27 system need in order to reliably manage the system. First, the spinning reserves
28 are charted for operators to visually see spinning reserves on a real-time basis.
29 This running chart provides operators a visual target for monitoring and

1 feedback. This is enhanced by an audible alarm should the spinning reserve drop
2 below the pre-set target. Another tool utilized by operators and others managing
3 the system is a forecasted standby generation staffing and operation chart. This
4 chart looks forward seven days and provides an indication of when Hydro should
5 have employees at standby generation facilities, either to staff and await
6 direction (if the reserves look adequate but are trending close to requirement for
7 start up) or to be at the facility to place the standby generation in operation for
8 system reliability purposes.

9
10 Hydro has taken action to provide for improved situational awareness for those
11 involved in managing the power system. Hydro will consider Liberty’s advice and
12 recommendations in future planning and institute any additional actions deemed
13 viable.

14
15 *4. Hydro should implement a more robust approach to the CERP.*

16 The existing CERP is a broad program designed to “assign specific responsibilities
17 to individuals within Nalcor’s corporate management structure as they may
18 relate to the provision of emergency support services to entities within Nalcor
19 during any emergency that may occur”. Liberty wrote “the decision not to
20 declare an emergency or activate its CERP reflects a culture that considers major
21 outages “normal” and easily managed.” Hydro does not agree with this
22 statement nor does it reflect Hydro’s operational philosophy. The circumstances
23 of March 4, 2015 are on the record in this matter and the knowledge of Hydro on
24 the morning of March 4, 2015 was that the supply to customers would be
25 restored in a short time frame, and therefore, did not constitute an emergency
26 necessarily requiring activation of CERP.

27
28 However, Hydro does note that the CERP is a managed document that is
29 reviewed annually as part of the company’s corporate management review

1 process. Since March 4, 2015, it was noted that the review of the CERP
2 document in the past has not included a person embedded in Hydro System
3 Operations; however, the ECC and the System Operations Department are
4 routinely consulted on all CERP process improvements. As part of the annual
5 CERP review process, Hydro will include personnel with experience in System
6 Operations or system response protocols. It is anticipated that this person’s
7 participation in the review will result in an improved CERP, with the aim of
8 providing enhanced guidance to operational personnel during system events
9 when they are required to make decisions on the activation of CERP. The
10 addition of a System Operations or operational response person can also
11 contribute to the discussion of Liberty’s recommendation of “intermediate alerts
12 where a full activation might not be needed”.

13
14 Hydro will consider Liberty’s advice and recommendations in future planning
15 with respect to CERP.

16
17 5. *Advance notification protocols should appropriately identify potential impact in terms of the*
18 *loss of power to customers.*

19 As previously discussed, Hydro has updated its reliability assessment and
20 notification protocols to include the communication of the Avalon capability and
21 reserve to Newfoundland Power, similar to what was currently in place for the
22 assessment and notification of Island Interconnected System capability and
23 reserve.

24
25 Hydro communicates daily with Newfoundland Power on the system reserves,
26 and in the event the reserves are trending toward an alert level or in an alert
27 level, will communicate more frequently as required. The content of the
28 communication contains the MW amount of reserves, which is compared to the
29 alert levels and required notification response, if necessary. If there is a
30 requirement to quantify unserved energy by customer numbers in advance of

1 shedding load, Hydro supplies the amount of MW the system could be deficient
2 but does not supply Newfoundland Power with customer totals as
3 Newfoundland Power has this information, and not necessarily Hydro.
4

5 If the undervoltage condition were to occur again, or an event where Hydro
6 could quantify a MW amount to be shed, Hydro would endeavour to quantify
7 the amount of MW to shed to regain system stability. Hydro would indicate a
8 required MW total, and Newfoundland Power would have the estimated
9 customer amounts to be impacted. If the undervoltage occurred rapidly, Hydro
10 does note that the agreed to and implemented undervoltage load shedding
11 scheme will now occur automatically, and so the ability to advise in advance
12 would be limited, and in some situations may not possible, similar to when an
13 underfrequency load shedding occurs and customers are not able to be provided
14 advance notice.
15

16 Hydro and Newfoundland Power jointly reviewed and updated the Joint
17 Communication Plan following the March 4, 2015 event. Reviews of this plan
18 will occur as required into the future and Hydro will consider Liberty's advice and
19 recommendations for future planning in this area where additional
20 improvements can be viably implemented.
21

22 **4. CONCLUSION**

23 Hydro remains committed to the provision of safe, reliable and least cost supply of electricity to
24 its customers. It has taken the lessons learned from the March 4 events, including Liberty's
25 comments, into consideration, and has and will continue to improve its processes. Hydro fully
26 expects the actions taken, and that Hydro will continue to take, will support Hydro's
27 commitment to provide reliable service for all customers.
28

29 ALL OF WHICH IS RESPECTFULLY SUBMITTED.