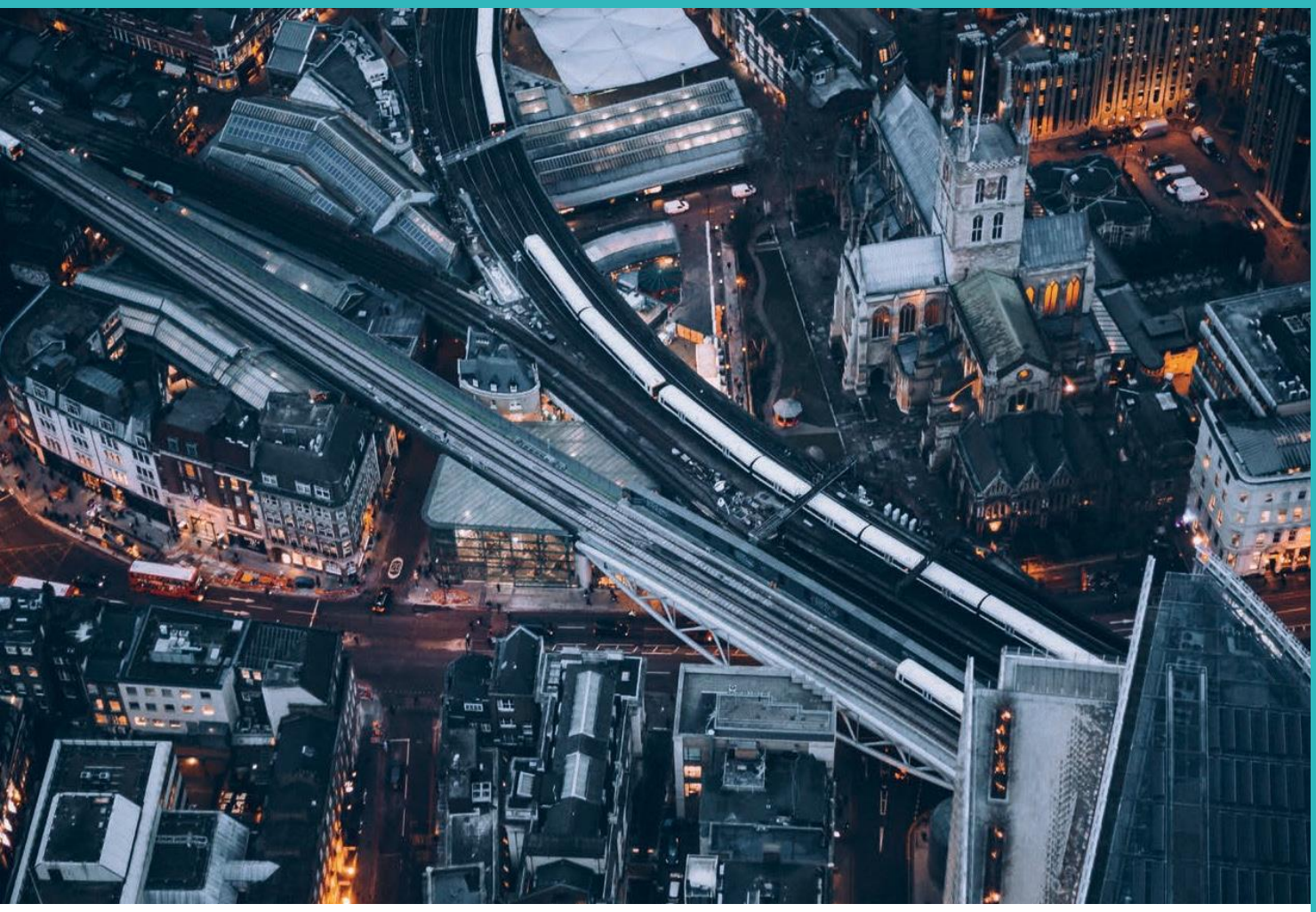

REPORT

Maritime Electric: Storm Fiona Emergency Response

Prepared for: The Prince Edward Island Regulatory and Appeals Commission

Report No: EA28630
Document Version: 2
Date: 12 February 2025

ea technology

Version History

Date	Version	Author(s)	Notes
19/09/2024	1	Andrew Harrison, Chris Wheldon	Initial Draft
12/02/2025	2	Andrew Harrison	Minor editorial changes including additional referencing following customer review.

Final Approval

Approval Type	Date	Version	EA Technology Issue Authority
Issue Approval	17/02/2025	2	Tony Dowd

EA Technology Limited, Capenhurst Technology Park, Capenhurst, Chester, CH1 6ES;
Tel: 0151 339 4181 Fax: 0151 347 2404

http://www.eatechnology.com

Registered in England number 2566313

Executive Summary

The Prince Edward Island Regulatory and Appeals Commission (the "Commission") has received an application from Maritime Electric (ME) to recover operating costs related to Hurricane Fiona and to record the capital portion of costs incurred related to Fionas' restoration into property, plant and equipment and be included in rate base.

The Commission have engaged EA Technology to carry out a review which comprises of 3 key elements:

1. A review of the causes of ME's electrical system failure.
2. The prudency of the costs incurred as a result of Storm Fiona.
3. Where applicable, opportunities to improve ME's reactive event preparation and response.

Summary of Review Findings

The review considers that based on the evidence presented, ME's current investment approaches appear to provide little opportunity to enhance system resilience and storm hardening to negate the impact of severe weather events. Investment and intervention approaches are considered to have a narrow scope.

However, prior to the onset of Storm Fiona ME has constructed and maintained the condition of the electrical system's primary asset base to a reasonable standard.

ME has acknowledged that tree contacts were a significant contributor to electrical supply interruptions prior to Storm Fiona.

Post Storm Fiona, ME have commenced increased levels of vegetation management activity across the region based upon enhanced vegetation management programmes albeit to the same limited cutting specifications.

The review suggests that even if vegetation clearances were to be rigorously maintained to ME's specification, clearances would be insufficient to prevent interference from the larger falling branches and trees flanking the rights of way during severe weather events.

Instances of preventable tree contacts, that should have been avoided through effective and reasonable vegetation management activity, will have increased the magnitude of the restoration effort, extending customer supply restoration times, increasing accrued costs and reducing overall levels of system resilience.

The review finds that ME's general approach to reactive emergency response events broadly follows expected practice. The evidence provided appears to demonstrate an adequate breadth of emergency event response provision in so far as the labour, materials, fuel, and welfare aspects of any planned response activity are considered within a formally structured process that defines four levels of emergency response. The deployment of provisions appears to have been made in a controlled and appropriate timely manner. The delivery response appeared to have followed a logical 'system needs first' based structured recovery plan.

The review has made a number of observations, identified some existing restoration approach limitations and potential future risks suggesting opportunities for ME review. These when considered in conjunction with advances in available technologies may reduce the burden placed on ME's responders and further improve ME's emergency response capability.

ME are understood to have only drawn response resource from providers and suppliers known to the organisation using pre-arranged contractual terms, and therefore financial mismanagement is unlikely to be an issue.

Conclusions

The review draws the following conclusions:

C1. The primary asset base which makes up ME's transmission and distribution power systems were considered to be in a generally good condition prior to the onset of Storm Fiona. However, from a vegetation management perspective, it appears that line corridors were not as well maintained.

C2. Prior to Storm Fiona ME appear to have had appropriate range of emergency plans, facilities, contractual arrangements and provisions to prepare for and support the majority of reactive response deliveries in a safe, timely manner. This range of provisions may now need to be reviewed for future large scale events.

C3. The scale of reactive response required following the passage of Storm Fiona is considered to have exceeded ME's emergency response provision, which in order to maintain a safe mode of operation has a finite resource capacity. This restriction is thought to have had a direct affect upon the pace of restoration delivery and customer outage duration.

C4. During the Storm Fiona response effort, ME had to respond to increased rates of system damage caused by preventable tree contacts. These contacts have contributed to a significant overall reduction to the overall system integrity and should have been avoided through effective and reasonable vegetation management activity. The scale of this response requirement is thought to have significantly extended customer's restoration times during Storm Fiona.

C5. ME's response to Storm Fiona was delivered in accordance with their Business Continuity and Disaster Recovery Plan, and included external assistance from approved contractors and suppliers, mutual aid partnership organisations and Fortis Group members.

C6. Although the full range of financial controls have not been evidenced, the resources utilised during the Storm Fiona response are understood to have all be subject to pre-arranged contractual terms and conditions, therefore the review considers that the costs associated with ME's reactive response is unlikely to be subject to financial mis-management, and have been prudently accrued.

C7. ME's post Fiona increase in vegetation management investment, including the development of cyclical vegetation clearance programmes are expected to improve overall electrical system performance on blue-sky days. However, due to current legislative restrictions and limitations these programmes are unlikely to prevent future windfall tree contacts during high wind weather events.

C8. The review has identified a number of response areas for ME to consider, these include:

- C8.1 The development of a cohesive long term system resilience building investment strategy which includes a greater diversity of investment options.
- C8.2 Approach to vegetation management restriction resolution.
- C8.3 Investment benefit quantification and prioritisation process.
- C8.4 Incident command structures for larger scale events.

Contents

1. Background and Introduction

The Prince Edward Island Regulatory and Appeals Commission (the "Commission") has received an application from Maritime Electric (ME) to recover operating costs related to Hurricane Fiona and to record the capital portion of costs incurred related to Fiona restoration into property, plant and equipment and be included in rate base.

Storm Fiona caused extensive damage when transiting over Prince Edward Island (PEI), uprooting trees, and instigated the largest storm response in ME's history. The approximate cost of the ME's claim application stands at $34.6m CAD (December 2022).

The Commission have engaged EA Technology to review the cause(s) of failure of ME's system, the prudency of the costs incurred as a result of Hurricane Fiona, and if appropriate to do so, identify clear and cogent ways by which ME can improve its preparation and response to future weather-related events.

2. Scope and Objectives

The review undertaken by EA Technology comprises of 3 key elements:

1. A review of the causes of ME's electrical system failure.

   Consideration of ME's stewardship of the electrical network that would directly affect the condition of the network prior to onset of Hurricane Fiona. The review also considers ME's inspection, maintenance, asset replacement strategies and other asset management practices, including vegetation management. Such factors have implications on the resilience of the network.

2. The prudency of the costs incurred as a result of Storm Fiona.

   The objective of this review element is to consider the appropriateness of ME's preparation for and response to Hurricane Fiona, including the prudency of the costs claimed by ME in relation to customer supply restoration or other issues requiring urgent attention.

   Prudency within this context can be defined as a combination of:

   - The ability to govern and discipline oneself by the use of reason
   - Shrewdness in the management of affairs
   - Skill and good judgement in the utilisation of resources
   - Caution or circumspection as to danger or risk

3. Where applicable, opportunities to improve ME's reactive event preparation and response.

3. EA Technology Team

With a combined knowledge and experience of over 150 years in the electrical transmission and distribution industry, the EA Technology project team who completed this review consists of specialist consultants with experience in hands-on operational activities and the management of storm events.

This includes participation in assisting other regional network operators with their storm event responses.

The team have previously held operational and management positions across the full spectrum of activities that span electrical system management, policy and standards, engineering, system control and asset management.

4. Review Process

4.1 Information Requests

EA Technology has followed an established Prince Edward Island Regulatory and Appeals Commission regulatory process to complete this review. This process involves the collection of information from ME via a round of information requests (IR's), 19th June 2024 followed by a technical session, 10th September 2024 with EA Technology, the Commission and representatives from ME. The purpose of the session was to clarify the responses to the IR's and provide answers to any follow-on questions.

The EA Technology review was predominantly focused upon the following documentation provided by the Commission[1] :

Commission Exhibits

- Exhibit C-6 Interrogatories from EA Technology to MECL Re. Fiona Application – June 12, 2024

Applicant Exhibits

- Exhibit M-4 – Hurricane Fiona Post Mortem Report – January 31, 2023
- Exhibit M-5 – Refiled Hurricane Fiona Post Mortem Report – March 7, 2023
- Exhibit M-13 – MECL Responses to EA Technologies Interrogatories Re. Fiona – July 26, 2024
- Exhibit M-13(a) – MECL Responses to EA Technologies Interrogatories – CONFIDENTIAL
- Exhibit M-13(b) – Appendix B – CONFIDENTIAL
- Exhibit M-13(c) – Appendix E – CONFIDENTIAL

4.2 Assessment Approach

A desktop review of the information supplied by ME has been completed remotely to:

- Determine the appropriateness of ME's reactive response preparations prior to Storm Fiona
- Form a view about the condition of the electrical network prior to Storm Fiona
- Review ME's inspection, maintenance, asset replacement strategies along with their other asset management practices, including vegetation management.
- Consider the potential impact of contingency plans that ME have in place to control costs during storm events.

[1] UE21505 – MECL Application to Collect Operating and Capital Costs Related to Hurricane Fiona

This involved comparing ME's adverse weather event preparations and provisions against those expected to be found within other high-performance utilities and industry best practice.

This review has been conducted independently, objectively, and will attempt to consider the subject matter contextually and wholistically to form a professional opinion regarding ME's ability to react to adverse weather events in an effective and cost-efficient manner.

5. Maritime Electric – General Information

The ME owns and operates an integrated system providing for the generation, transmission and distribution of electricity to customers throughout PEI employing approximately 220 personnel, and is a wholly owned subsidiary of Fortis Inc. a publicly traded Canadian multinational diversified electric utility holding company which is headquartered in St. John's, Newfoundland and Labrador.

ME is a Public Utility regulated by the Island Regulatory and Appeals Commission (IRAC). This requires that any applications for electricity rate changes and operational expenditures are subject to IRAC's directive approval prior to implementation.

ME has a portfolio of electrical generation, transmission and distribution assets reportedly valued to be in excess of CA$500 million. These include subsea interconnector cables, 2 generating stations and an electrical transmission and distribution system comprising of over 127,000 pole structures and approximately 6,600 km of transmission and distribution lines which span the 5,600 km^2 province.

6. Brief Overview of Storm Fiona

Storm Fiona is widely considered the most intense post-tropical cyclone to hit the north eastern region of Canada on record and brought with it the greatest storm impact in Prince Edward Island's recent history with interruption to transport links, essential infrastructure, and energy supplies. The storm made contact with PEI on the evening of Friday 23rd September 2022 and delivered peak wind speeds exceeding 130 kilometres per hour across the island. Windspeeds reached 150 km/h at East Point, island-wide rainfall exceeded 60 mm, with 117 mm reported in Murray Harbour. The storm combined with a high tide and a storm surge of approximately 2.0 metres occurred along the north shore. The central pressure for Fiona was the lowest recorded barometric pressure to make landfall in Canadian history at 932.7 hPa.

Restoration of ME's system started at daybreak on Saturday, 24th September 2022, for approximately 83,200 customers who were left without power. At that time, the majority of the transmission and distribution system was out of service.

In response to this prolonged adverse weather event, ME are understood to have undertaken the largest restoration effort in the Company's history. Activities relating to the restoration effort continued for 3 weeks, with the last customer supply energisation taking place on Friday October 14th. A total of CA$34.6 million of storm restoration costs were incurred during the restoration effort to repair the network and safely restore the electricity supplies to all connected customers.

Remedial works, vegetation surveying, clean up works and damage repairs to weakened infrastructure taking place in the months directly following the event.

Over 205 power line crews, 59 vegetation management crews and many other supporting resources such as Canadian Armed Forces personnel, damage assessors, field supervisors, and traffic control personnel were mobilised to storm affected areas at the height of the restoration effort. Power line crews installed approximately 1,275 distribution poles, 140 km of conductor, and 445 transformers including associated insulators and hardware during the Storm Fiona restoration effort.

7. Review Findings

The review has considered a wide range of subject areas and activities which would be expected to make or affect an electrical system operators storm response. This includes emergency response planning, pre-planned provisions for labour and materials, the effectiveness of both internal and external communications and the delivery of the response from a customer perspective.

A high-level view of ME's network stewardship and approach to asset management has also been considered during this undertaking in an attempt to understand the design, configuration and condition of ME's primary electrical system, the extent to which vegetation management specifications, programmes and deliveries were being made immediately prior to the onset of Storm Fiona. Such factors are considered by EA Technology's review team to have a direct bearing upon levels of inherent system resilience and the extent to which critical infrastructure can be regarded as susceptible to failure.

The following sections of this document outline the main review findings relating to ME's reactive response, paying particular attention to the events associated with Storm Fiona.

7.1 Causes of Maritime Electric's System Failure

The review considers that based on the evidence presented, ME's current investment approaches appear to provide little opportunity to enhance system resilience and storm hardening to negate the impact of severe weather events. Investment and intervention approaches are considered to have a narrow scope.

However, prior to the onset of Storm Fiona ME has constructed and maintained the condition of the electrical system's primary asset base to a reasonable standard.

ME has acknowledged that tree contacts were a significant contributor to electrical supply interruptions prior to Storm Fiona.

Post Storm Fiona, ME have commenced increased levels of vegetation management activity across the region based upon enhanced vegetation management programmes albeit to the same limited cutting specifications.

The review suggests that even if vegetation clearances were to be rigorously maintained to ME's specification, clearances would be insufficient to prevent interference from the larger falling branches and trees flanking the rights of way during severe weather events.

Instances of preventable tree contacts, that should have been avoided through effective and reasonable vegetation management activity, will have increased the magnitude of the restoration effort, extending customer supply restoration times, increasing accrued costs and reducing overall levels of system resilience.

7.1.1 System Configuration & Design

When compared to other typical electrical system operators around the world, ME's electrical system is comparatively small and reflective of a remote, island based, rural system operator who is primarily focused on the cost of delivery to end users. Information contained within IR-1 of Exhibit M-13 – MECL Responses to EA Technologies Interrogatories Re. Fiona -July 26, 2024 provides an overview of the electrical transmission and distribution networks. Whilst the system contains some redundancy, the majority of the network employs a predominantly radial circuit arrangement and contains a fairly low number of transmission and sub-transmission voltage routes. Electrical structures may carry more than one electrical circuit, and it is common practice for distribution structures to carry circuits operating at different system voltages. This type of arrangement is understood to also include combinations of protection system pilot wires and fibre-optic communication links potentially owned by other utilities.

In typical blue sky conditions, such system design features can be viewed as an efficient use of space and materials which minimise the costs of service delivery. However, during adverse weather conditions, the failure of shared overhead line spans and or structures represents a single point of failure which can result in multiple electrical system disruptions.

Exhibit M-5 – Refiled Hurricane Fiona Post Mortem Report – March 7, 2023 suggests that ME's electrical system suffered from a relatively modest number of electrical failures at both transmission and sub-transmission voltage levels. However, it is apparent that these individual incidents have collectively resulted in a significant reduction in system availability and the loss of customer supplies which may have been avoided if the system were more resilient and contained true aspects of redundancy by design.

To be truly effective, redundancy must extend beyond a simple duplication of electrical circuits, and avoid common modes of failure such as shared circuit routing, the use of shared structures, or even construction type/standard. Resilient network design would also be expected to include opportunities for system re-configuration and supply restoration, ideally via an automated or remote-manual means. The review understands that ME's system contains a small number of split ring (radially arranged) circuits and some limited telemetry facilities. However, opportunities to enhance system resilience and response recovery by making improvements to the general approach to system design / configuration are thought to be possible.

Exhibit M-13 (IR-4) states that difficulties have been experienced with telemetry and SCADA systems. Communication paths appear firstly not to contain aspects of redundancy, or functional contingency in the event of power loss or as a result of storm damage. This in turn has limited ME's ability to remotely assess unplanned plant movement and identify power outages in real time, reducing the effectiveness of the initial impact assessment and response co-ordination.

The evidence presented suggests that ME are looking to invest in advanced secondary system technologies to enhance in-house capabilities in the future. The resilience benefit of these investments remains unclear.

7.1.2 Electrical System Condition

IR-6 within Exhibit M-13 states that ME's electrical network has been built to recognised Canadian standards which have been subjected to local adaption. Where deviations from national standards have been made, ME have verified the designs using nonlinear analysis methods using PLS-CADD software to confirm the adequacy of design against ME's acceptability thresholds. ME state that adaptations include distribution line conductor tensioning and framing modification in recognition of their local geological conditions that have been found to cause issues when anchoring electrical structures.

The evidence supplied by ME (Table 2 IR-1, Exhibit M-13) suggests that the electrical network comprises of relatively young assets, from which the review panel would infer, that in the event that construction and ongoing maintenance has been completed correctly to either recognised ME and or Canadian standards, would have been expected to be in a reasonably good condition immediately prior to the onset of Storm Fiona – Although this has not been verified as ME state in IR-1(c) of Exhibit M-13 that their asset management system is not able to report on either asset health or residual working life expectancy. EA Technology and several regulatory authorities globally, consider these metrics as the industry standard form of leading indicator from which likely system performance estimations should be based, and forward-looking risk based investment decisions can be justified.

7.1.3 Investment Approach

ME appear to manage their electrical asset base through a programme of exception reporting and targeted investment/intervention. Collectively the evidence reviewed illustrates, at a high level, the inspection, vegetation management and maintenance cycle schedule to which ME are currently working and shows an intent to steadily ramp up vegetation management activities through to 2025.

Generally, the review panel have found that where organisations report by exception asset investment takes place either reactively or via a range of inconsistent parameters and criteria which continually change. ME have not supplied sufficient evidence to comprehensively describe their asset management approach across all asset classes, or the mechanism by which investment benefits are either quantified, considered, or compared.

Exhibit M-13 (IR-66) implies that some form of analysis which combines defect tracking, rates of unplanned power outage occurrence, and load consideration takes place which appears to be logically based. However, clarity of investment decision making criteria and prioritisation has not been fully conveyed and is therefore considered to be at risk of individual judgement which may deliver inconsistent outcomes.

To the EA Technology review panel, Exhibit M-13 portrays ME's asset replacement strategy as an approach which focuses on maintaining existing standards of network design and construction rather than an approach specifically designed to sustainably build system resilience and flexibility.

The review has formed the opinion that there is a potential reliance upon rates of rudimentary like-for-like asset replacement. ME's default position is to continually replace overhead lines and their associated components with an identical (or 'closest to' equivalent) construction standard to the retired asset, rather than completing a formal risk based, financially quantified investment determination, currently regarded as representing industry best practice to deliver the most appropriate solution. Taking such a restrictive view when considering potential future investments limits comparison of alternative investment strategies, investment effectiveness, and return on investment.

ME would likely argue that adopting this approach is excessive given the size of the organisation and its asset base, and that continued cost pressures mandate this pathway. However, recent advances in asset management decision making support tools are not always expensive and have been found to deliver significant returns. When complimented by a practical and pragmatic approach to risk quantification, these tools can become very powerful.

There is little evidence to demonstrate that, prior to Storm Fiona, ME were considering a wide range of alternative investment options on a day-to-day basis when making network related investments. The review also finds little to support that this situation has changed post Fiona.

The review would expect to see a leading electrical system operator electing to construct overhead line infrastructure to different (enhanced/higher voltage) construction standards at distribution voltages, the routine deviation and or the undergrounding of line segments or complete routes. This may include system re-configuration and or the provision of additional system redundancy.

Within both MECL-Climate-Change-Risk-Assessment-filed-February-10-2023 and Exhibit M-13 (IR-59), ME state that undergrounding overhead power lines is too expensive, and in some circumstances is thought not to be practicable. However, there is a recognition that where customer services are placed underground the subsequent reduction in ongoing maintenance and vegetation management could be used to offset the difference in capital installation costs. This review would expect to see a wider range of lifecycle orientated investment optioneering taking place, both when making routine investment decisions and when attempting to overcome operational difficulties that result in poor system performance. Within the evidence made available for review, ME have only demonstrated that a limited number of alternative construction approaches would be considered during the development of plans for new connections, and not within routine Investment and or intervention strategies.

7.1.4 Vegetation Management

Prior to the onset of Storm Fiona ME identified tree contacts as a significant cause of unplanned power outages, and state that they have increased rates of expenditure in this area recently. The review understands that ME are improving their vegetation management practices by developing cyclical programmes of inspection and clearance informed by an enhanced risk-based approach driven by vegetation species and anticipated growth rate information.

However, in 2022, prior to the onset of Storm Fiona, the results being delivered by ME's vegetation management practices at the time were recognised as being inadequate. ME state within the 2023 General Rate Application that vegetation contacts were found to be responsible for around 33% of unplanned overhead line outages during blue-sky conditions.

From the evidence supplied to this review, it appears that vegetation management prior to Storm Fiona was only taking place on a piecemeal basis following routine line inspection that identified potentially hazardous situations or following reports from concerned customers who may have been experiencing poor system performance.

This indicates to the review that the condition of ME's line corridors immediately before the onset of Storm Fiona were not as expected, and therefore contributed little to the resilience of the system when faced with an adverse weather event.

Appendix H of Exhibit M-13 contains details of ME's vegetation management clearances. These clearances are understood to be restricted by current legislation relating to utility strips and rights of way dimensions. ME have made clear that as an organisation they do not have the powers to carry out vegetation clearance or tree cutting on private properties, and that they rely upon a combination of customer negotiation, advice and education as a primary means of dispute resolution.

EA Technology's review team firmly agree with the statements contained within the Hurricane Fiona Post Mortem Report (Exhibit M5) which recognise that even if vegetation clearances were rigorously maintained, they would be insufficient to prevent interference from the larger falling branches and trees flanking allotted rights of way. ME recognise that the current line corridor rights of way are insufficient to prevent treefall damage during significant events and are understood to be actively lobbying for additional powers to enhance vegetation management practices in to the future, which aligns with the review team's perspective of the situation.

7.1.5 EA Technology's Network Stewardship Observations & Conclusions

- Electrical systems which are predominantly of radial design offer fewer opportunities for re-configuration and or the use of alternative supply arrangements than other network topologies and are considered to offer less resilience to unplanned supply interruption events.
- Although ME are currently unable to demonstrate asset health, the condition of their electrical system's primary assets was considered to be generally good immediately before the onset of Storm Fiona.
- From a vegetation management perspective, it appears that prior to Storm Fiona line corridors were not well maintained.
- Inadequate line corridor vegetation management will directly affect the number of locations at which unwanted tree contacts will occur during both blue-sky and adverse weather events.
- Responding to increased rates of system damage caused by preventable tree contacts that should have been avoided through effective and reasonable vegetation management activity has been observed to significantly increase customer supply restoration times during major storm events.

- Poor ground conditions have a direct bearing upon trees ability to withstand high winds during periods of adverse weather. Trees whose root systems are situated in shallow, wet, sandy ground are more susceptible to windfall.
- ME's post Fiona increase in vegetation management investment, including the development of cyclical vegetation clearance programmes will improve system performance on blue-sky days. However, current legislative restrictions and limitations are unlikely to prevent future windfall tree contacts during high wind weather events.
- Transmission construction standards permit greater vegetation management clearance distances. Consequently, replacing critical distribution lines or specific route segments with transmission-level construction could enhance system resilience against tree contacts due to the expanded corridor rights-of-way. However, this approach involves trade-offs, including higher installation costs and potential visual impacts versus the alternative of increasing the vegetation clearance on the route would also need to be considered. Stakeholder engagement and agreement are essential to determining the most effective solution.

7.2 Prudency of Storm Fiona Costs

The review finds that ME's general approach to reactive emergency response events broadly follows expected practice. The evidence provided appears to demonstrate an adequate breadth of emergency event response provision in so far as the labour, materials, fuel, and welfare aspects of any planned response activity are considered within a formally structured process that defines four levels of emergency response. The deployment of provisions appears to have been made in a controlled and appropriate timely manner. The delivery response appeared to have followed a logical 'system needs first' based structured recovery plan.

The review has made a number of observations, identified some existing restoration approach limitations and potential future risks suggesting opportunities for ME review. These when considered in conjunction with advances in available technologies may reduce the burden placed on ME's responders and further improve ME's emergency response capability.

ME are understood to have only drawn response resource from providers and suppliers known to the organisation using pre-arranged contractual terms, and therefore financial mismanagement is unlikely to be an issue.

7.2.1 Reactive Event Provision

When EA Technology consider the range and depth of a network operators emergency response provision, the review team take into account the network operator's size, location, specific geography, and available in-house resource.

The review considers that ME's general approach and range of emergency response provisions and their associated controls have not been fully evidenced, are either based upon or rely heavily upon historical events, are highly dependent upon workforce judgement and previous experience, but they broadly represent expected practice.

ME have formally documented processes to make reactive responses, for example the Business Continuity and Disaster Recovery Plan which the review understands was actioned during Storm Fiona. Such documents appear to contain specific event definitions, assign roles and responsibilities, and co-ordination between system control resources.

From Exhibit M-13 (IR-23) and the clarifications made during the technical session, EA Technology understands that ME have pre-arranged contractual arrangements with established materials and service providers which cover additional labour, materials, specialist vehicle hire, transport and logistics, fuel, and welfare facilities that extend to include the supply of food and hotel accommodation for response personnel. ME state that where necessary any such arrangements include specific manpower experience, qualification or electrical certifications, each having a regularly reviewed fixed price/rate.

The application of emergency plans and provisions has been found by the review as being a predominantly manual undertaking that is highly dependent upon the previous experience and judgement of those responding to reactive events. Evidence to support this notion is clear from the response to Exhibit M-13 (IR-26).

Emergency response provisions which are subject to an individual's interpretation are generally considered to be more susceptible to the potential risk of delivering inconsistent outcomes, and ME have not demonstrated the range of available controls to protect against this eventuality.

To be clear, ME's response determination immediately prior to Storm Fiona appears to have been actioned correctly, and as described in the Business Continuity and Disaster Recovery Plan which makes provision for a range of emergency event types.

7.2.2 Storm Fiona Preparation

In Exhibit M-13 (IR-26 & IR-27) ME outline their weather monitoring provisions which appear to have correctly identified the threat posed by Storm Fiona, tracking its progress as it approached the north eastern region of Canada regularly acquiring weather updates and trajectory forecasts from a variety of weather service providers. From the evidence made available to this review, ME are understood to have undertaken a programme of weather tracking and monitoring, and employed a variety of communication tools to provide advanced warning of the impending event, including its forecast magnitude to its customers. Exhibit M-13 (IR-61) outlines the multi-channel approaches employed which conveyed a message to make preparations for a sustained large scale weather event that had already been observed to have caused extensive damage to other jurisdictions whilst on route to the region.

As the storm approached, ME enacted a formal emergency response to the pending event, delivering a response which stood up the organisation's internal resources, engaged and mobilised approved external contractors, moved materials and their suppliers to a state of readiness and opened additional Emergency Control Centres. Pre-arranged assistance contracts are understood to have been actioned in sufficient time to facilitate agreed mobilisation and lead times prior to the event, and so the review concludes that the process of resource deployment and pre-placement prior to Storm Fiona reaching PEI appears to have been as described in ME's documentation (namely the Business Continuity and Disaster Recovery Plan and Exhibit M-13 (IR-28 & IR-30)), timely, and reasonably well organised.

7.2.3 Response Delivery

The review acknowledge those who contributed to the largest emergency response effort in MEs history, and fully appreciate the difficulties experienced in such challenging circumstances.

Initially, given the evidence presented, as the restoration to Storm Fiona took weeks not days, it appeared to the review that the magnitude of Storm Fiona's impact exceeded ME's available response capacity and capabilities, and that further calls for mutual-aid were either unanswered or delayed through a combination of engagements from neighbouring jurisdictions, difficulties accessing PEI, all being compounded by resource limitations and the effects of market forces.

However, during the technical session clarification was sought and ME provided the review with assurance that this was not the case, and that additional resources were available, engaged and mobilised to support their restoration effort. ME have stated that supervision limitations were encountered as responding resource was ramped up. These difficulties were overcome by the temporary promotion of ME line crews and mobilisation of additional approved resources from external contractors and the wider Fortis Group.

During the technical session, ME were challenged as to whether they could have increased responding resource levels further in an attempt to speed up the pace of restoration. ME stated that the maximum number of response crews that could be safely deployed was constrained by the available number of ME supervisors/crew leads. ME consider that a safe level of supervision can only be provided when the number of managed crews is between 5-7 per supervisor, and that anything exceeding this level represents an unacceptable safety risk.

The number of crews (powerline and vegetation) deployed exceeded 260, considered by ME as the maximum resource capacity that could be safely controlled. Exhibit M-13 (IR49(b)) leads the review towards the opinion that ME have previously experienced difficulties in this area previously during larger scale events such as Storm Dorian, and therefore already had some understanding of their incident command structure limitation.

The review finds many positive aspects to ME's Storm Fiona response, this includes smooth processes for on-boarding and orientating external resources, the maintenance of existing safety requirements and construction standards being applied within a structured framework of system recovery based on both system and customer need. Provisions such as those intended to protect against shortages in materials supply were enacted, and

were reportedly effective, as were the processes which record the existence of any temporary repairs and or non-conformities on ME's geographic information system.

ME have stated that their specifications for overhead line poles, conductors, and associated line gear are closely aligned to that of neighbouring system operators, and that any variances are considered unlikely to adversely affect the integrity of the repaired electrical system. However, the way in which differences in equipment specifications may impact ME's future asset management programmes (e.g. maintenance and life expectancy ambition) have not been fully explained.

7.2.4 Incurred Costs

ME are the main supplier of electrical energy on PEI, an island province of eastern Canada located in the Gulf of St. Lawrence, accessible either by air, sea, or the Confederation (road) Bridge which forms part of the Trans-Canada Highway, all of which are likely to be directly affected by what may be regarded as localised weather and climatic influence.

The review therefore feel that it is foreseeable that in the event of adverse weather, which includes high winds and heavy climatic precipitation events, access to and from the island may be restricted. An example of the evidence provided to support this position can be seen in Exhibit M-13 (IR-30). The review therefore acknowledges, understands and accepts this situation, and would expect that ME would likely accumulate additional operating costs on a regular basis when mobilising additional external resources and materials in preparation for the possibility of responding to potential reactive events - purely due to the logistical realities of operating with this geography. As are the implications of making such decision calls at an appropriate point in time that would enable an effective response when the certainty of event realisation is not always clear.

In light of this predicament, and the absence of evidence to the contrary, the review team can only be assume that given their experience in this area, ME have historically managed to successfully exercise their judgement to effectively control the costs associated with this type of decision making to an acceptable level.

The review finds that due to the pre-arranged nature of the contractual arrangements made by ME (see exhibit M-13 (IR-23) prior to the onset of Storm Fiona, rates for labour, poles, conductor, and associated materials, including externally sourced service providers were known in advance of the event. Therefore, the review considers that the vast majority of response costs are likely to have been accrued at a known rate and will have been dependent upon the efficient delivery of the organisations recovery and restoration plans.

The review would expect that cross charges between neighbouring jurisdictions and other mutual-aid responders who were able to exchange plant and materials would do so at a premium. Given the circumstances surrounding the event, this is only to be expected and as long as controls are in place to ensure there is no exploitation of supplier position, then the review can only assume incurred costs were acceptable to ME at the time. Evidence of such controls has not been made available for review.

The review notes that a financial report has been compiled to verify that ME have applied the correct financial allocation to accrued costs. ME have also confirmed that during the response effort, crew leads are responsible for the accurate completion of event based time sheets for those deployed to on-site operations.

However, ME have not explained the processes by which they are able to demonstrate effective financial control through accrued cost reconciliation, or how response efficiency is measured (perhaps in terms of resource utilisation or quantification of idol/waiting time), reviewed and subject to continuous improvement.

During the technical session, ME demonstrated a commitment to operational safety when questioned about levels of resource engagement. When numbers of responding resources were challenged ME presented a compelling argument which showed an understanding of their capacities and capabilities when making reactive responses, and a willingness to make big, bold decisions regarding levels of assisting resource.

The review believes that if faced with another similar scale event to that of Storm Fiona, or even a larger event requiring a bigger reactive response, ME would take the same decisions to limit engaged resource level in order to maintain effective control and co-ordination of response teams.

The review believes that when ME is able to draw upon its known emergency provisions and resources to make a reactive response, financial mismanagement is unlikely to be an issue.

7.2.5 EA Technology's Prudency of Incurred Storm Fiona Costs Observations & Conclusions

- ME appear to maintain an appropriate range and depth of emergency response provision which includes documented processes with assigned roles and responsibilities, pre-arranged contractual agreements for additional labour, materials and services.
- ME review the adequacy of their emergency response provisions during post-event reviews. The outcomes of these post-mortems is used to inform future improvement.
- ME's application of emergency plans and provisions has been found by the review as being a predominantly manual undertaking that is highly dependent upon the previous experience and judgement of those responding to reactive events.
- Emergency response provisions which are subject to an individual's interpretation are generally considered to be more susceptible to the potential risk of delivering inconsistent outcomes.
- ME's response immediately prior to Storm Fiona appears to have been actioned correctly, and as described in the Business Continuity and Disaster Recovery Plan. However, ME's Storm Fiona response was constrained by the available number of ME supervisors/crew leads.
- ME have stated that during the response to Storm Fiona, they made a conscious decision on the grounds of safety to limit the number of responding powerline and vegetation management crews in order to maintain effective control of deployed resources.
- The implications of limiting levels of response resource when recovering from events such as Storm Fiona are known to have a direct impact on the pace of customer restoration, extending re-connection times and adversely affect levels of customer satisfaction.
- As ME appear to have only drawn upon its own known and pre-arranged emergency provisions during Storm Fiona, the incurred costs are likely to have been accrued in a controlled manner with the likelihood of financial mismanagement being considered unlikely.

7.3 Improvement Opportunities

This section of the report outlines the potential areas of opportunity identified by EA Technology during the review.

7.3.1 Emergency Response Level Categorisation

ME's Business Continuity and Disaster Recovery Plan defines four levels of emergency event and outlines the anticipated response in each case. For each event scenario the plan indicates the means and provision by which emergency responses should be made and the anticipated source of any labour and or materials are to be sourced.

Smaller events rely upon in-house resources working overtime with support from material stores. As the scale of the emergency response increases, ME's plans include a requirement for external assistance from trusted service providers and if required draw down plant and materials from contingency stocks held by approved suppliers. With larger events seeking mutual aid assistance from neighbouring system operators and/or the wider Fortis Group organisation.

When considering the larger event end of the emergency response scale, ME's planned provisions appear:-

- Not to differentiate between "localised" and "regional" events;
- Assume that any requests for mutual assistance can be answered and appropriately resourced.

EA Technology define a "localised" event as a range of circumstances in which either a single utility or system operator is exposed to a threat which directly affects the integrity of their system without causing damage to the infrastructure of neighbouring operators in adjacent provinces. This differs from "regional" magnitude events in which extensive damage is experienced over a widespread geographic region resulting in a reduction of available resourcing availability to provide either mutual aid or externally sourced contracting assistance.

During the course of the review, the review has seen no evidence that ME make a differentiation between these potential future scenarios which implies that ME are working upon the assumption that all calls for mutual-aid will be answered and that neighbouring system operators and or the Fortis Group will always be able to provide both an adequate and appropriate blend of response resource.

Over recent years the magnitude, severity and frequency of adverse weather events similar to that of Storm Fiona has been observed to be steadily increasing. Each requiring a progressively larger emergency response and recovery effort than the last. ME may have recognised this emerging trend, but appear not to have reflected it within its current range of emergency plans.

ME appear not to have considered the possibility that it may face larger regional scale events in the future, either of a similar or greater magnitude to Storm Fiona that may cause extensive damage and disruption far beyond the shores of PEI and its surroundings, Events in which the damage sustained extends beyond the historically narrow transitory corridors of previous storms, and leave ME in the situation whereby mutual-aid calls cannot be answered or resourced in either a timely or efficient manner as other system operators and third parties and their associated agencies look to make similarly sized reactive responses.

It may now be the time for ME to consider how they will be able to deliver a timely and effective emergency response into the future, and the possibility that existing mutual aid / PMO agreements may be unable to provide what ME need.

7.3.2 Command Structure & Rate of Response Delivery

EA Technology completely understand and respect the strength of the argument presented within the previous storm response costs section regarding ME's decision to limit the numbers of engaged response resources to a level such that they remain comfortable and able to effectively manage the restoration activities to recover from Storm Fiona.

On the one hand this approach can be seen as a positive and decisive course of action designed to reduce the risk of accidents, injuries and unsafe practices. However, limiting the amount of response resource in this way also demonstrates the limitations of ME's approach, and provides the opportunity for an outsider looking in, to question the appropriateness and scalability of the command and control structure employed by ME during Storm Fiona.

During our deliberations, the review team have made reference to some of the fundamental principles of professional project management, particularly those relating to work breakdown structures, task sequencing and resource assignment and optimisation.

Every project, including reactive response undertakings can be broken down into their component parts, and are often represented in the form of work breakdown structures. Individual tasks can be assigned with estimations of the required effort to facilitate completion, which are used to inform delivery programmes which can be sequenced and optimised to ensure delivery costs and timeframes are understood.

During project execution, it is not always possible to deliver even some of the best laid plans, and often through a combination of latency, technical difficulty and or logistical delay, delivery timescales become affected. In order to reduce the risk of late delivery, an effective project manager will adjust levels of manpower and assigned resource often accepting that doing so will result in the accumulation of additional costs and generate diminishing returns with increasing resource level.

When at saturation, either through maximum delivery capacity, or reduced delivery effectiveness, the only way to either maintain or increase rates of work completion is to change your approach. This can either be via the adoption of different working practices, new technologies, delivery plan revision, or changes to command structure.

During their response to Storm Fiona, EA Technology consider that ME have made a number of judgement calls and got a lot of things right, including the decision to moderate levels of response resource and activity upon the grounds of safety – it's importance cannot be overstated. However, the consequences of this resource limitation will have had a direct impact on the duration of the overall restoration effort. EA Technology believe that ME's review evidence has not fully conveyed their customers thoughts and sentiments relating to the Storm Fiona restoration effort, and questions whether ME's customers are prepared to tolerate the outage durations experienced during Storm Fiona when faced with future weather events? Or whether a change in response command and control approach would be either warranted or beneficial?

7.3.3 Resilience Strategy

In light of the fact that many of the issues affecting electrical system performance appear to be known to ME, the organisation should develop a cohesive long term, forward looking asset management strategy designed to build system resilience and address the issues identified within this report.

7.3.4 ME's Use Of Technology & Communications

Based upon the evidence reviewed it appears that the majority of ME's response processes, communication methods, and information flows are manually processed, paper-based, and more labour intensive when compared to more modern technologically orientated approaches/delivery systems.

In addition to the asset management limitations discussed in section 7.1.3, the review finds little evidence of field based technologies being routinely applied within ME, or of technologically based solutions being applied

to vegetation management, storm impact, damage assessment, repair planning, resource and materials dispatch.

Technological solutions and modern-day decision support tools, have the potential to improve the speed, reliability, and accuracy of a range of both day-to-day and emergency response activities. They can provide consistency of response, reduce process latency through faster data processing, and often bring with them additional facilities which reduce the burden on limited in-house resources, and enhance an organisation's ability to communicate with its customers.

ME may wish to consider the potential benefits of including Light Detection and Ranging (LiDAR) surveys into routine overhead line patrols to inform vegetation management activity, or the adoption of software based storm damage impact assessment tools to assist in the identification of vulnerable network sections, assist in the estimation of response requirement, or to enhance the means through which customers are provided with a more accurate and realistic restoration time estimate. Whilst ME have numerous facilities and channels with which communications can be made, including websites and social media, it appears to the review that there are clear opportunities for improvement when considering the timeliness, accuracy, reliability and effectiveness of the information communicated in these areas.

7.3.5 Overcome Vegetation Management Restriction

In conjunction with their efforts to educate and negotiate with land owners to enable the widening of vegetation corridors clearances, ME should continue to lobby the appropriate authorities to instigate changes to current legislation to facilitate a less restrictive vegetation management programme.

EA Technology considers it unlikely that a utility like ME will obtain the authority to clear vegetation universally, however, it may be able to present an argument which provides additional powers for specific strategic circuits, designated critical feeders or essential supplies.

ME should also consider adoption of practices employed by other system operators in the region that have been designed to appease customers affected by programmes of mandatory vegetation clearance. Consideration may be given to either the replacement of troublesome trees/vegetation with alternative species which have a more acceptable growth rates, or by providing a commitment to replant at another location on a like for like basis.

8. Conclusions

The review draws the following conclusions:

C1. The primary asset base which makes up ME's transmission and distribution power systems were considered to be in a generally good condition prior to the onset of Storm Fiona. However, from a vegetation management perspective, it appears that line corridors were not as well maintained.

C2. Prior to Storm Fiona ME appear to have had appropriate range of emergency plans, facilities, contractual arrangements and provisions to prepare for and support the majority of reactive response deliveries in a safe, timely manner. This range of provisions may now need to be reviewed for future large scale events.

C3. The scale of reactive response required following the passage of Storm Fiona is considered to have exceeded ME's emergency response provision, which in order to maintain a safe mode of operation has a finite resource capacity. This restriction is thought to have had a direct affect upon the pace of restoration delivery and customer outage duration.

C4. During the Storm Fiona response effort, ME had to respond to increased rates of system damage caused by preventable tree contacts. These contacts have contributed to a significant overall reduction to the overall system integrity and should have been avoided through effective and reasonable vegetation management activity. The scale of this response requirement is thought to have significantly extended customer's restoration times during Storm Fiona.

C5. ME's response to Storm Fiona was delivered in accordance with their Business Continuity and Disaster Recovery Plan, and included external assistance from approved contractors and suppliers, mutual aid partnership organisations and Fortis Group members.

C6. Although the full range of financial controls have not been evidenced, the resources utilised during the Storm Fiona response are understood to have all be subject to pre-arranged contractual terms and conditions, therefore the review considers that the costs associated with ME's reactive response is unlikely to be subject to financial mis-management, and have been prudently accrued.

C7. ME's post Fiona increase in vegetation management investment, including the development of cyclical vegetation clearance programmes are expected to improve overall electrical system performance on blue-sky days. However, due to current legislative restrictions and limitations these programmes are unlikely to prevent future windfall tree contacts during high wind weather events.

C8. The review has identified a number of response areas for ME to consider, these include:

- C8.1 The development of a cohesive long term system resilience building investment strategy which includes a greater diversity of investment options.
- C8.2 Approach to vegetation management restriction resolution.
- C8.3 Investment benefit quantification and prioritisation process.
- C8.4 Incident command structures for larger scale events.

C8.5 Opportunities for the adoption of new technologies.

technology

Safer, Stronger, Smarter Networks

EA Technology Limited
Capenhurst Technology Park
Capenhurst, Chester CH1 6ES

t +44 (0) 151 339 4181
e sales@eatechnology.com
www.eatechnology.com