STATE OF VERMONT
PUBLIC UTILITY COMMISSION

Case No. 23-____-PET

Petition of Green Mountain Power for approval	)
of its Zero Outages Initiative as a Strategic	)
Opportunity pursuant to 30 V.S.A. § 218d and	)
GMP's Multi-Year Regulation Plan	)

PREFILED DIRECT TESTIMONY OF
MICHAEL BURKE
ON BEHALF OF GREEN MOUNTAIN POWER

October 9, 2023

Summary of Testimony

Mr. Burke provides an overview of how Green Mountain Power (GMP) will significantly accelerate climate resiliency work for customers so that they experience zero outages by 2030, through GMP's Zero Outages Initiative. This will be accomplished through a combination of work to protect against severe storms and other events by hardening the grid and providing direct resilience in communities and at customer locations through energy storage. All of these solutions also will support a more dynamic, clean, decentralized, and affordable electric system for all customers. Mr. Burke explains how the overall Zero Outages Initiative builds on GMP's previously approved Climate Plan, outlines the testimony of other GMP witnesses, and summarizes the proposed treatment of these investments during the Multi-Year Regulation Plan period. He also specifically addresses the methods, scope, and prioritization of transmission and distribution projects needed to achieve this work.

TABLE OF CONTENTS

EXHIBIT LIST

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ON BEHALF OF GREEN MOUNTAIN POWER

I. Introduction and Witness Summary

Q1. Please state your name and occupation.

A1. My name is Michael Burke. I am the Vice President of Field Operations for Green Mountain Power ("GMP").

Q2. Please describe your background.

A2. I have worked for GMP since 1997, serving in many roles with the company, including customer service, meter service, and engineering design prior to my current role leading field operations. Since 2009, I have served as the field operations chief and now Vice President of Field Operations at GMP, overseeing the planning and execution of all our Transmission and Distribution ("T&D") field activities, including all restoration efforts from severe weather events and GMP's Climate Plan work. I also oversee work on pole attachments and broadband deployment and am a member of the Rural Resiliency and Adaptation subcommittee of the Vermont Climate Council. I received a Business Management degree from Champlain College, completed the Vermont Department of Labor Lineworker Apprenticeship three-year course, and have taken numerous engineering and operations courses while at GMP.

Q3. Have you previously testified before the Public Utility Commission ("Commission" or "PUC")?

A3. Yes. Among other cases, I was a witness in GMP's Climate Plan proceeding, Case No. 20-0276-PET, and in the proceedings that established GMP's current Multi-Year Regulation Plan ("MYRP" or "Plan") and Fiscal Year 2023 base rates under that Plan, 21-3707-PET and 22-0175-TF.

Q4. What is the purpose of your testimony in this case?

A4. I summarize this filing which builds off our existing Climate Plan, and I explain why it is critically important that we accelerate both reliability and resiliency right now, and in the years ahead so that Vermonters stay powered up in the face of climate change and other threats. I also introduce GMP's witnesses in support of the Petition and summarize what we are seeking in this filing. I then describe the specific T&D strategies we will use to accomplish this important work for customers.

Q5. What is GMP's Zero Outages Initiative?

A5. As I describe in further detail below, the "Zero Outages Initiative" is a phased, data-driven plan that consists of three major components that work together to create an energy system by 2030 where customers can experience zero outages, all while reducing costs:

1) Undergrounding Lines. Our Zero Outages Initiative prioritizes a rapid deployment of undergrounding primary distribution lines. As I explain below, in many cases, this has become more cost-effective than overhead construction and results in a much more reliable energy system in the face of extreme weather.

2) Spacer Cable and Tree Wire for Overhead Lines. Our Zero Outages Initiative requires that all 3-phase or primary overhead lines—for example, so-called "main feeders" that leave substations and feed the power into entire Vermont towns—are storm hardened with insulated, strong lines that can withstand much more damage from trees.

3) Energy Storage for All. We then achieve the zero outages aspect of this Initiative by providing energy storage resiliency in all homes and communities through a combination of battery storage, microgrids and new technologies such as incorporating electric vehicles in the home and on the grid.

At the highest level, the Zero Outages Initiative is our focused commitment to rapidly transform the grid by: 1) strengthening both the reliability and resilience of the Vermont grid to meet the increased severity of climate change and other threats; and 2) delivering a clean, affordable, connected and dynamic energy future for Vermont. As further outlined in this filing, the Zero Outages Initiative provides several overlapping benefits and is driven by our focus on safety, equity, and affordability. No matter who you are or where you live, you will be a part of a reliable, resilient energy system that is clean, affordable, and there when you need it most.

Phase 1 of this comprehensive initiative, described in this filing, will rapidly accelerate all these efforts in the next few years starting where it is needed the most: rural areas of southern and central Vermont where severe climate change driven storms are hitting hardest and disproportionately impacting those customers. During this phase, we

will also build the statewide roadmap and systems to ramp up this work throughout all of our service territory so that customers will not experience any outages by 2030.

Prior to Phase 2 of this Initiative, we will seek approval from the Commission to accelerate and expand beyond FY26. We prefer a phased approach because, not only does it allow us to focus first on the most severely impacted parts of the state, but it also allows us to incorporate all technological advances and other factors such as federal funds and incentives that will lower the overall cost of these important investments. As we implement projects during the first phase, we will also be able to refine the required trajectory in the subsequent years to achieve the Zero Outages Initiative. This data-based analysis will be critical to informing what the overall level of investment will be to deliver the Zero Outages Initiative by 2030 and ensuring cost effective energy for Vermonters for many years to come.

Q6. Why is the work GMP is proposing to accelerate to achieve zero outages important for customers now?

A6. We have all seen the heartbreaking and devastating impacts of climate change here in Vermont, the region, the country, and beyond. The past 10 months went beyond anything Vermont has experienced before—starting in December 2022 and through September 2023, there were six major storms.[1] This is unprecedented. These storms tore through the

[1] A Major Storm is defined in GMP Service Quality & Reliability Performance, Monitoring & Reporting Plan ("SQRP") as a storm which meets all three of the following criteria: (1) extensive mechanical damage to the utility infrastructure has occurred; (2) more than 10% of the customers in a service territory are out of service due to the storm or the storm's effects; and (3) at least 1% of the customers in the service territory are out of service for at least 24 hours. GMP SQRP at 12.

state, causing extensive damage and repair costs in the tens of millions. This Zero Outages Initiative is an urgent response to these impacts, bringing together a multi-layered approach to deliver for customers the comfort and safety they expect.

The time is now. We can no longer wait. It is critical that we rapidly accelerate proven solutions to help Vermont because climate change means we will see even more of this severe weather in the years ahead. We can build on GMP's success in proactive undergrounding and storm hardening lines, and in deploying energy storage that keeps customers and communities connected and helps better strengthen the grid. This work will mean we can avoid outages and grid damage throughout our rural territory and help customers and communities stay powered up even when damage does happen. In this way, the Zero Outages Initiative is an innovative partnership with customers and communities to bring all of this work together, further strengthening the grid by creating a dynamic, decentralized, technologically advanced two-way system where we are providing service seamlessly for customers. This will help customers weather any storm, and also better prepare Vermont to withstand any physical, cyber, or other threat from the regional grid.

A changing climate has resulted in, among other things, a much longer and more significant growing season. Vermont is much different than it was when the power lines were originally constructed. Vermont was then largely pastures and fields rather than dense forested area. Vermont's warmer, wetter weather has accelerated these growth patterns significantly, as noted in our last Climate Plan, and these same weather changes also create intense storm systems that hit more frequently and with more ferocity. This

means large trees outside of our rights-of-way are succumbing to wind, rain, and heavy, wet snow. Maintaining our rights-of-way with vegetation management techniques is therefore no longer enough. Additionally, the longer growing season is resulting in rights-of-way that will require much more expensive and frequent trimming. This will increase costs to an unsustainable level. We must stop these ever-escalating costs and the good news is we have the proven solutions now to do so by implementing the strategies in our Zero Outages Initiative of undergrounding where possible and storm hardening overhead lines with spacer cable and strong, insulated wire.

Anticipating and preparing for the damaging storms is also challenging our state and our country's weather forecasters, as weather patterns are unpredictable and are bringing far worse weather than traditional models can predict. We cannot change this worsening weather, but we absolutely can adapt more rapidly to protect customers from it. The only sustainable and affordable path for our customers and for Vermont is to move at a faster pace that recognizes the challenge we all face, and the benefits meeting that challenge will bring. That is why we need to expand delivery of lasting solutions that provide customers with peace of mind that they will stay powered up. Our Zero Outages Initiative will focus on solutions that are working now for customers, including undergrounding, storm hardening like overhead spacer cable, and energy storage through managed solutions in the home, microgrids, and Resiliency Zones.

As towns and communities grapple with impacts from these storms, helping them stay powered up also means supporting their towns, local officials, and emergency managers to better support their citizens by making sure critical infrastructure like town

water and wastewater plants, town garages and Town Halls remain in service. The Zero Outages Initiative is targeted to help regardless of the size of the town, distance from a substation, or population.

While technology continues to evolve rapidly and we know more tools will be available soon to help—including emerging ways to connect electric vehicles to buildings, individual loads, and the grid (referred to as "vehicles to everything" or "V2X")—we have everything we need right now to scale up this work. We have effective methods to deploy and a regulatory framework that will allow us to achieve a connected, coordinated, resilient grid throughout our territory in Vermont. We have been using these tools for many years now, including local, distributed generation, energy storage, and load management systems.

Our Zero Outages Initiative is also very important in ensuring an affordable and reliable shift in Vermont away from fossil fuels in transportation and heating, the two largest sources of carbon emissions in Vermont. All of this will work together to benefit customers and keep everyone connected no matter what.

Pursuing this additional work now is also important in allowing us to utilize the statutory permitting exemption to Act 250 enacted this past legislative session (Act 47 of 2023). It will also position GMP to be able to seek and deploy all federal funding and tax attributes for grid hardening, customer resilience, and electrification that have become available under the Inflation Reduction Act. All the reasons above are why we are seeking this Strategic Exception now, to allow for much greater investment in the next

two years than currently allowed in the MYRP which will set the stage for the work remaining to complete the Zero Outages Initiative by 2030.

Q7. Please explain further what type of work is included in GMP's Zero Outages Initiative.

A7. During the unprecedented storms over the last several years, some Vermonters have already experienced the benefits of the type of work planned under our Zero Outages Initiative and did not experience an outage as a result of the work in our Climate Plan and our innovative programs. Regarding spacer cable and other storm hardening work, a couple clear examples of already implemented and proven solutions stand out to me from the recent storms:

- During one recent major storm, I was communicating with one of our experienced lineworkers who was repairing storm damage in a hard-hit part of the state in Sharon, VT. Eleven trees from outside the right-of-way were laying on a forested section of distribution line between Sharon and Strafford, VT. He indicated that the customers in that area did not experience an outage due to those trees because we had rebuilt the overhead lines with storm hardened spacer cable. When the crews completed restoring other outages elsewhere, they went and safely removed these trees from that line.
- After the major storm this March, I attended a community meeting in Grafton, VT where customers told us how distribution lines in Athens – another area with storm hardened infrastructure – withstood the damage from falling trees and

stayed on and in the air, even though extensive infrastructure damage occurred all around.

These are examples of the storm hardening line work we intend to rapidly accelerate across the grid through this filing to reach zero outages by 2030 for customers. Since 2020, we have already performed this type of work on over 330 miles of distribution line.

Additionally, we have already undergrounded over 50 miles of distribution lines since 2020 and these sections experienced no damage during the recent storms. We will massively increase the amount of undergrounding on our system through our Zero Outages Initiative. Undergrounding is now often more cost-effective overall than storm hardening overhead single-phase distribution lines and we can also use undergrounding when conditions warrant on three-phase main lines. Undergrounding is a critical part of how we will keep customers connected, in combination with storm-hardened measures including spacer cable for main line feeders where aboveground lines make sense.

And finally, approximately 3,000 of our customers have connected storage systems leased or owned through our Energy Storage System ("ESS") tariff, our Bring Your Own Device ("BYOD") tariff, or a pilot program. Many of them who live in areas hit hard by this year's storms stayed powered up while we repaired damage to infrastructure that caused outages for their neighbors. The Zero Outages Initiative will ramp up delivery of customer storage systems directly to those neighbors—to those who live in areas of rural Vermont hardest hit by the damages these storms cause and often least able to pay—so that they too stay on. These types of customer systems, plus microgrids and community-level storage, are critical tools to not only help customers

avoid the impacts more frequent, damaging storms cause but also stay connected when the regional grid is threatened by other events, all while helping us day to day manage the grid even more effectively for all customers, and with greater equity too. With storm hardening and undergrounding work, these storage solutions at the community and customer level, create a three-pronged approach to achieve zero outages and a stronger, resilient grid across our territory.

Q8. How does GMP's Zero Outages Initiative support the work GMP is already pursuing for customers under the MYRP and its prior Climate Plan?

A8. Since approval of our Climate Plan in 2020, now incorporated into our Integrated Resource Plan ("IRP") and MYRP capital investments, we have deployed significantly more projects into our annual work that enhance reliability and resiliency across the state. Our lived experience of the past several years here in Vermont, along with the challenges we see across the region and around the world, tell us that this proven work must be implemented at a much faster pace and with greater urgency. This filing will help us do that by seeking a strategic capital exception to the overall capital investment limits in the MYRP[2] of up to $250M in T&D projects and up to $30M in customer and community energy storage. This will allow us to significantly increase this work over the remainder of the MYRP and develop the scale needed to accomplish zero outages for all customers throughout our territory by 2030. We propose regulatory treatment of the Zero Outages Initiative that is consistent with the treatment utilized in both our approved Climate Plan

[2] See MYRP at Section IV(A)(6) (Unexpected Circumstances and Strategic Opportunities).

and the Broadband Deployment Tariff Rider—adding each project to the overall cost of service only after the project is completed.

Q9. How is this filing structured?

A9. My testimony outlines why and how we are building on our Climate Plan work by approaching grid hardening and resiliency work in different zones of our service territory in a comprehensive, data driven way that looks at each circuit. I discuss how we are approaching this work now and over the next few years during the current MYRP period. I then focus on specific distribution system work now underway that supports our Zero Outages Initiative and explain how we will deliver on these types of projects for customers in the years ahead if this filing is approved.

Josh Castonguay describes how GMP's resiliency work, specifically energy storage and microgrids, is critical to ensuring zero outages in combination with the T&D storm hardening work. He also explains how this work supports not only resilience but also electrification for the benefit of equitable, affordable service for all customers. He explains how important it is to equity that the benefit of staying connected and powered up can be realized by all our customers, no matter their location or ability to afford their own solutions. He describes our request to expand this work significantly in the next few years through an up to $30M additional investment, and how we plan to expand this work in the years ahead across our distribution network under the Zero Outages Initiative, subject to future authorizations as appropriate.

Finally, Laura Doane explains the proposed regulatory accounting structure for this Zero Outages Initiative work, which relies on the well-established accounting methodologies previously approved under GMP's Climate Plan.

II. The Increasing Impacts of Extreme Weather in Vermont and Importance of Reliability

Q10. In the last year since GMP's Current MYRP has been in place, can you provide more detail regarding how weather events have impacted GMP's T&D system and what this has meant for customers?

A10. Storms over these past twelve months have been the most costly and impactful in GMP's history. As shown in **Exhibit GMP-MB-1**, which is a statewide outage map that covers the past three years and incorporates all the severe storms we have experienced in the last twelve months, it is very evident where the storms usually hit hardest: along the slopes of ridgelines and in the central and southern parts of Vermont. During this past winter customers experienced multiple heavy, wet snowstorms that knocked over large trees, blocked roads, broke poles, and took down wires across our territory, leading to thousands of outages that lasted for days for some customers, as local and external crews worked with local responders to clear roads and reach infrastructure through deep, concrete-like snow. Summer also brought very severe weather to areas of the state, including another major storm due to thunderstorm activity and the worst flooding the state has seen since Tropical Storm Irene.

In our approved Climate Plan, we filed testimony from expert meteorologist Roger Hill, a long-time weather consultant for Vermont, explaining the climate change

impacts Vermont can expect in the years ahead. I attach that filed testimony again here, because it explains why we are experiencing the types of storms we saw this past winter and why we need to expect these effects will continue and worsen in the years ahead. *See* **Exhibit GMP-MB-2**. In short, Vermont's climate is getting wetter and warmer. In wintertime, more heavy wet snow events that can tear down trees, and in turn knock down poles and lines, will become the norm. In the summer, tropical downpours that quickly inundate communities will continue to occur. All of this has other impacts, such as saturating and destabilizing soil and creating faster vegetation growth both of which in turn increase the likelihood of tree-caused outages, particularly when gradient winds increase. Mr. Hill's report at the time of the Climate Plan is backed not only by Vermont's recent storm experience but also by updated assessments of the future effect of climate change in Vermont by the National Oceanic and Atmospheric Administration's latest State Climate Report, available at https://statesummaries.ncics.org/chapter/vt/ and attached as **Exhibit GMP-MB-3.**[3]

The storm in March 2023 provides a specific example of the changing and unpredictable winter weather. This started with winter storm warnings in just the southern two counties ahead of the event, and then quickly expanded northward with warnings moving during the event all the way to the Canadian border. The early forecasting did not reflect the dynamic, damaging storm that hit the state. We prepared for these storms by bringing in additional crews and staging our teammates across the

[3] The updated State Hazard Mitigation Plan, currently in the process of adoption, also highlights these effects. See State Hazard Mitigation Plan, Chapter 4, available at: https://vem.vermont.gov/document/draft-2023-shmp-section-4-vermont-profile-hazard-assessment

state and with robust customer, town, and state leader communications. The storm that hit proved very damaging. From March 14 to 16, Vermont received precipitation in the form of heavy, wet snow that approached the water equivalent levels of rain experienced during Tropical Storm Irene in some areas. In southern Vermont, roadways were blocked, and lines were toppled by large trees that could not handle the snow. Crews found themselves at times in waist-deep dense snow attempting to reach downed trees and infrastructure to restore power to customers. In some locations, whole areas of soil on sloped banks a distance from our lines gave way, collapsing down hillsides, blocking roads, and toppling poles and wires.

Then in July, Vermont experienced historic flooding—beyond what was experienced in Tropical Storm Irene in some locations. While the immediate flooding and property destruction were the most devastating impacts, it was also a Major Storm for our customers due to the impacts to the electric system, washing out roadways and trees alongside our power lines. We responded quickly to restore power wherever possible, and during the ongoing recovery have also helped those whose properties were damaged by coordinating with other agencies to provide expertise and information on system replacements and electrification upgrades. Before and after that event, all in the month of July, significant flash flooding continued, resulting in outages in localized areas—most severely in Killington, Rutland, and parts of Addison County. All of this provided a stark example of how increasing heat and humidity will lead to more intense and frequent severe storms with damaging winds in the summer, and even into September as we experienced just last month when thunderstorms in southern Vermont rolled through.

Some customers we spoke to described the incredible, terrifying power of that system as it tore by their homes, causing enough damage to become the sixth Major Storm over the last twelve months.

In the fall and spring, the higher moisture content in the warmer air leads to stronger and deeper low-pressure systems that create damaging gradient wind events. These gradient wind events, depending on the direction the storm comes from, interacts with Vermont's geography by down sloping and gaining speed down ridgelines and into communities. We have seen these wind events increasing in both frequency and intensity, including in this past winter with Winter Storm Elliot on December 22, 2022, which included the second highest wind speed ever recorded at Burlington International Airport, and broke approximately 70 poles in our Middlebury Service Center area alone.

Of course, these storms are not just hitting Vermont, but the entire region, across the country and the world. We have all seen the heartbreaking climate impacts elsewhere that have devastated some communities through floods, fires, extreme summer heat, heavy blizzards in winter, hurricanes, tornadoes, and other events. From historic flooding across New England this summer, to extreme fire events in Canada, the western U.S., and most recently in Hawaii, the damage caused by these events, and costs associated with recovery are increasing and compounding. So far in 2023, the United States has already experienced more billion-dollar weather events than ever in a single year, and the frequency of these events is increasing: NOAA recently noted that while the U.S. has experienced approximately eight individual billion-dollar weather events per year since

1980, this average has jumped to 18 per year in the past five years (between 2018-2023).[4] We must expect to see these types of extreme events here more frequently too, even events like tornadoes and fires that typically have not been impactful in Vermont. We cannot wait and let these events continue to cause recurring damage here. Instead of reacting to worsening climate change impacts by continually repairing infrastructure after storms, Vermont can set an example, by rapidly delivering solutions that benefit all customers.

Q11. How will the Zero Outages Initiative improve Vermont's reliability in the face of the recent weather events?

A11. Imagine that when these types of storms or other grid-wide events hit, through a combination of undergrounding, storm hardening and storage innovations, customers remain powered up. Instead of tall trees out of the right-of-way taking down poles and wires during extreme storms, customers no longer lose connection for days. And if there are more extensive problems on the grid, community and home storage solutions allow our customers to stay powered up. To keep Vermonters connected we need to think differently and bigger. It is no longer just about preparing for severe weather when it is forecasted, maintaining rights-of-way, and repairing damage as quickly and safely as possible. We must transform our overall energy system to withstand a changed climate and different, severe threats like cyber and physical attacks. That thinking prompted our Zero Outages Initiative.

[4] *See https://www.ncei.noaa.gov/access/billions/*; see also https://www.cbsnews.com/news/us-sets-record-for-billion-dollar-natural-disasters-climate-catastrophes-in-2023/

Fortunately, the solutions available now for customers address these risks—we just need to scale them up so more Vermonters have access to them, at a much faster pace, no matter where they live. T&D improvements—including sectionalizing reclosers, tree wire and spacer cable and undergrounding, along with customer and community resilience solutions like microgrids, onsite energy storage, and storage-paired generation work together to avoid impacts and create zero-outage service for customers in all these extremes.

Q12. Tell us more about the specific impacts of these weather events for customers?

A12. These storms have taken a tremendous toll, affecting Vermonters' sense of safety and security in ways that are incalculable. Some of the most vulnerable Vermonters we have encountered in our outreach during storms are those living in the most rural parts of the state, many aging, without resources, and often receiving healthcare services at home (a service that is growing rapidly, making reliable, resilient power even more important). It is these customers that are in the front of our minds as we do this work, knowing that the hardships they face are like those many of their neighbors also face now or will face in the years ahead. That is why we are proposing our Zero Outages Initiative, to much more quickly deploy solutions that will keep our customers powered up, safe, and able to meet their needs.

Ahead of any forecasted event, we prepare. We plan crews and resources to help manage restoration as quickly and safely as possible. We reach out directly to customers with information, and then we continue to engage throughout the storm and restoration. We have a team that talks directly to customers who need electricity for oxygen and other

medical support. We check in on them by updating on the status of restoration, encouraging them to have a plan for their equipment, and by providing needed aid at times to them, in partnership with first responders. We engage with communities on preparation ahead of events and throughout on emergency response and restoration.

It is very costly to restore service after significant storm events. As indicated in **Exhibit GMP-MB-4**, the amounts incurred for just the most recent six major storms in the last twelve months are approximately $45M. This is in addition to the approximately $8M per year in routine and recurring smaller storm response. In total, since 2014, there has been over $115M just in direct major storm costs, with 2023 being the highest ever experienced. More than 60% of that total is just in the last 5 years, and 40% in the last two years. *See* **Exhibit GMP-MB-4** (Ten Year Major Storm Costs).

In addition to these direct costs for outage repair, there are financial, social, and emotional costs to our customers every time an outage occurs—impacting their daily life and livelihoods, especially with an increased number of customers continuing to work from home. There are also safety risks for our customers and crews. As the statewide map of outages over the last three years shows in **Exhibit GMP-MB-1**, these effects fall disproportionately on rural Vermonters where the infrastructure is most at risk and is the most challenging to repair. The purpose of our Zero Outages Initiative is to deliver better outcomes for all our customers, including the most rural, providing solutions that have multiple, lasting benefits. Through this work we can rapidly and proactively deliver projects that will achieve a more integrated system that customers can rely upon and that will provide benefits all the time, even during extreme weather.

Q13. How do these direct storm costs compare to the investments you are seeking in this Zero Outages Initiative?

A13. When Vermont experiences extreme weather that creates major storm restoration costs, we utilize the adjustor mechanism in the MYRP to smooth impacts to customers. Even with the steps we have taken to lower and smooth these for customers through the structure of the adjustor, the rate impact is significant and unsustainable. If the major storm costs from FY23 were to be recovered in a single year, like they were incurred, it would be approximately a 7% rate impact. Even with the smoothing under our regulation plan, the FY23 storms alone will add approximately 2.3% to rates over the next three years. Meanwhile, that same level of investment in T&D capital projects for undergrounding distribution lines and storm hardening main line feeders is spread over 45+ year life of these assets and creates a one-year rate impact that is many multiples lower than the cost of repair.

Capital investment for reliability and resiliency projects has a far lower rate impact than the expensive, unsustainable status quo, which is to continually repair the system after intense damaging storms and incur day-to-day vegetation management costs that will only continue to significantly increase. The investment we are seeking approval for in this filing—up to $250M for additional T&D projects and up to $30M for additional energy storage between now and the end of FY26—would not exceed an annual 2% rate impact. As stated above, the cost of major storms in FY23 alone was equivalent to a 7% rate impact if recovered in a single year.

Q14. Do you have results from storm hardening work already completed in recent years that show the benefits to the grid and customers that can be achieved?

A14. Yes. These projects are working and benefiting customers through reduced outages and lower costs. A good example is in the Bristol and Lincoln, Vermont area. There, we undertook a series of storm hardening projects, the last of which was completed in 2021. Prior to starting these projects, this circuit (representing approximately 11 miles) experienced an average of more than seven outages per year across all customers on the circuit. The area is very challenging geographically, with mountainous terrain high up along the Green Mountain ridgeline near Lincoln Gap, where higher winds and frozen precipitation are more common. We moved sections of the line to roadside from cross-country locations and, importantly, we added spacer cable and insulated, stronger tree wire. The results were just what we hoped for: The average annual outages for all customers on that circuit dropped to less than two outages. Heat maps showing outages in this area from 2014 to 2017 followed by one after the completion of all these projects in 2021 are attached as **Exhibit GMP-MB-5**.[5]

The data from these projects not only show the benefits of these storm hardening techniques, but it also points the way to the important, deeper work we have ahead. Even after completion of the storm hardening work on the T&D system in this challenging area, some customers still have experienced outages, though at a far lower level—and there are still customers at the end of lines in the woods of Lincoln whose locations are

[5] While not depicted on these exhibits because they involve other circuits, we also completed recently projects in Bristol (on Lower Notch Road) and Starksboro (near the Jerusalem Market) that address other reliability-challenged clusters.

shaded yellow, who experience more than 15 outages a year. Through the Zero Outages Initiative, in this area and throughout similar rural areas in our territory, we would address these either by implementing additional storm hardening projects, including undergrounding where possible, or by installing energy storage at their homes, thereby eliminating the outages these customers experience.

Q15. Please describe in more detail a few representative projects that you are building right now, following the storms this past year; what do these projects involve and what improvements are they expected to create?

A15. We worked immediately to implement a series of accelerated projects to increase reliability and enhance resilience for customers, particularly in the southeast area of the state with the most significant impacts from the recent winter storms, wind, and flooding events. A map of outages from the recent winter storms overlaid with the projects we are accelerating now to complete as quickly as possible is attached as **Exhibit GMP-MB-6.**

These projects include undergrounding, aboveground storm hardening on main line feeders, and automated controls. I describe below in more detail a few example projects and how they meet our customers' needs. The **Exhibit GMP-MB-6** depicts the specific line projects that will help address the outlying areas that are shown in red; in other words, a single line hardening project in Westminster, for example, will help many rural customers fed off the line clustered in that area and toward Putney, while another project will reach up from the other directly from Putney to aid reliability for other customers. The exhibit also depicts the Grafton area, where in addition to line hardening,

we have an active pilot program that is providing storage directly to some customers in the most rural areas of that town.

Another important example of this type of work is our planned set of projects around the VH4A line, which runs from Route 30 in Townsend, traveling west-southwest along dirt roads in Wardsboro, and terminating in East Dover. The project is mainly along three-phase segments with some single-phase segments in East Dover. Along the VH4A line, we have six different aspects in various stages of planning and implementation, with work already underway on State Forest Road in Townsend. This set of projects will prioritize underground construction wherever possible. In other places, overhead spacer cable will be used. Similar projects are planned and have started elsewhere in this part of the state, including, for example, main line feeds between Jamaica, Townsend, and Newfane, and from the Village of Saxton River all the way to the Athens and Grafton area. Numerous other projects are expected to commence work shortly.

These projects will have a direct and positive impact on reliability and resiliency for the customers served by them, as well as all our customers through avoided outage response costs. They will improve reliability during normal conditions and smaller weather events by hardening the lines so they are better able to carry power through routine tree contacts, pole-car accidents, and other incidents that might otherwise create a fault and cause a power outage. During larger and more severe weather events, these projects will help the mainline feeders and lines withstand damage to a higher threshold of weather impacts, helping customers in those areas. In more rural residential areas,

where Vermont now has the largest tree-canopied areas, we are working in these projects to get these areas mainly underground wherever possible.

Q16. What criteria did you use to select these projects?

A16. As set forth in the Climate Plan and our current IRP, we use several criteria to select and move forward projects, designed to maximize the impacts the projects will have for the customers and load being served.

The criteria include:

- Type, age, condition, and location of asset;
- The number of customers served by each circuit;
- Outage hours and overall reliability of the existing line and infrastructure;
- Review of where the project falls within the 20 least reliable circuits; and
- The critical facilities and community resources served by the circuit.

See IRP at 3:18-22.[6] Our selection balances all these criteria along with information directly from field workers and our continued assessment of outage improvements based upon factors such as permitting, availability of equipment, personnel, and materials. Wherever possible, we prioritize projects that deliver multiple benefits to customers, such

[6] We also described these criteria specifically in our approved Climate Plan: "With respect to resiliency work on distribution circuits, GMP will use several criteria to rank circuits, or sections of them, based on the magnitude of the impact the hardening investments will have for the customers and load served by each, using: twenty lowest-performing circuits/outage history during storm metrics; type, age, condition, and location of asset; the number of customers served by each circuit; outage hours and expected benefit from hardening; and the critical facilities served by the circuit…. No single factor will be determinative of the specific prioritization of any individual project." *See* GMP Climate Plan, filed Sept. 29, 2020 in Case No. 20-0276-PET, at p. 6-7.

as burying lines to eliminate overhead maintenance costs and improve safety; implementing overhead line storm hardening with spacer cable and tree wire; deploying feeder backup; and relocating off-road lines for safer and more efficient access. These upgrade projects improve not only safety but also often improve line capacity and lower line loss.

III. The T&D Strategies to Accelerate Climate Reliability and Resiliency Work to Achieve Zero Outages for Customers

Q17. In the Zero Outages Initiative, will you use the same criteria as developed in the Climate Plan to accelerate the work beyond these projects?

A17. Yes, the Zero Outages Initiative is a phased acceleration of our Climate Plan work and, as described further below, we will deploy the same criteria approved in the Climate Plan in developing projects throughout each zone in our distribution system. We expect to take a circuit-by-circuit approach, looking at each of our 300 circuits to deploy solutions for customers that combine T&D work with energy storage where needed. That work will happen in concert, creating Zero Outages circuits throughout our service territory between now and 2030.

Q18. How will these T&D upgrades coordinate with storage and innovation projects to achieve Zero Outages for customers?

A18. Mr. Castonguay addresses this in more detail, but in summary, we will deploy these T&D upgrades in combination with community- and customer-specific solutions so that customers stay powered up even when storms or other events challenge the grid. The work we are already doing across the state illustrates how we will achieve this for all

customers, including storage delivered through GMP's ESS and BYOD tariffs, a resiliency pilot in Grafton, Resiliency Zone microgrid projects in Rochester and Brattleboro, a zero-outage circuit federal grant proposal in Bethel, a comprehensive resilient neighborhood pilot in a new construction community in South Burlington, community storage supported by a statewide federal grant for low- and moderate-income customers, and planned Resiliency Zone solutions in Guilford and Rockingham, with others to come. These types of innovative storage solutions will pair with T&D work to support our Zero Outages Initiative.

We work as one team across GMP to consider what technologies and solutions can be deployed at the community or individual customer level, along with traditional infrastructure, to find the optimal solution to deliver reliable and resilient service to customers. We also consider the growth of electrification that is needed to decarbonize our state. As we have implemented our Climate Plan, we consider how storage, other distributed resources, or a combination of solutions can be used rather than only a traditional infrastructure upgrade. A combination of solutions is best to accomplish all of what the modern grid can do for customers: save customers money by reducing power supply and transmission expense; increasing reliability and resiliency thereby reducing future outage response costs; increasing operation efficiency and flexibility; and making our entire energy delivery system stronger for customers.

Q19. How are you planning to coordinate T&D and storage investments throughout your territory to deliver zero outages?

A19. Customers are the center of everything we do, and we are focusing on their experience to plan how we can deliver reliable, resilient, affordable, and renewable power through this initiative. We are thinking through our system by zone to address the right solutions throughout the state and to our most rural customers, so that all of them can experience zero outages service while we enhance our connected, coordinated grid territory-wide. Customers currently in urban or suburban areas, even though they may experience an occasional short outage due to a car pole accident or other unusual event, often speak of how they basically do not experience power outages; this is the experience we want all our customers to have, through a combination of grid work and storage.

There are advantages to this combined approach that go beyond lower overall deployment costs. For example, energy storage at both the community level that are part of a microgrid—and directly in customers' homes or businesses—allow for shared access and load management, as well as powering customers through when there are outages on the grid. Once at scale, storage resources will also guide our restoration and damage response, allowing us to deploy a more efficient set of resources.

Q20. As background, please describe how the distribution system is organized, from the least rural to most rural networks?

A20. At a high level, we think about the T&D system in four broad zones. These run from main line distribution feeders that tie substations together and travel out to our first protective devices on an electrical circuit (Zone 1), to three phase radial tap lines (Zone 2), to long single-phase distribution lines that serve dozens of customers or more (Zone 3), to single phase lines that serve smaller groups of customers, typically 1 to 10

customers (Zone 4).[7] The attached **Exhibit GMP-MB-7** provides a visual representation of these zones. We developed this zoned approach to apply the proven solutions available in each zone to help efficiently meet the goal of providing reliability and resiliency solutions for all customers. We illustrate this zone analysis to specific circuits in **Exhibits GMP-MB-8 and GMP-MB-9,** which shows the zones in the East Jamaica circuit and the Bethel circuit, respectively.

Q21. Explain further how these distribution system zones will help you plan for projects and the types of solutions that are a part of this Zero Outages Initiative.

A21. These four zones allow us to identify strategies that are most effective in addressing customized resiliency within each zone, building to zero outages across our service territory.

Zone 1 represents lines from the substation to the first protection device or tie point to other main lines feeds from adjacent substations. In general, all Zone 1 areas are backbones to T&D operations and tend to be closer to population centers, typically three-phase distribution service and carry all customers off that electrical circuit. While targeted undergrounding may be used where conditions allow, these lines commonly require overhead storm hardened solutions such as spacer cable and tree wire along with circuit tie reclosers and other automated technology, in addition to poles of appropriate height, strength, and age. We expect storm hardening projects to be prevalent in Zone 1.

[7] A protection device is a piece of equipment that helps detect faults on the system and isolate those portions of the system affected to keep other portions operating. Certain fuses and breakers, along with reclosers, are examples of protective devices.

Zones 2 and 3 are sections of distribution lines between protection devices. Zone 2 has a higher customer count and typically more than a single-phase distribution. Zone 2 lines typically carry both commercial and residential customers and do not tie to adjacent substations. Zone 3 lines are in settings that are typically residential single-phase distribution with 10-20 customers or higher. In both of these zones, undergrounding will be a preferred solution wherever possible, with storm hardening overhead projects where it is not.

Zone 4 lines are typically single-phase lines feeding the fewest customers per line mile, often single customers. Accelerated storm hardening of the infrastructure in all of these areas would be a very significant undertaking and likely not cost-effective in all locations; where that is true, providing storage directly for individual customers will be a preferred solution, especially given the multiple benefits it provides. In the future, when Zone 4 areas that are not storm hardened are due for replacement due to age, we will storm harden then with undergrounding preferred.

Q22. Describe in more detail the type of main-line feeder improvements you contemplate accelerating.

A22. For main line feeder work (Zone 1), we plan to use spacer cable for storm hardened construction for the majority of the work. Spacer cable is a fully insulated line that takes advantage of an over ½" thick steel cable messenger that sits above the insulated aerial cable, protecting that cable from tree strikes or other hazards. The other benefit of spacer cable is that, on all but the end of cable runs, there are no cross arms, so the spacer cable

three-phase configuration is only about 18" across leading to less tree contact because it has much less surface area than the typical 8' cross arm construction. Here is a picture:

Spacer cable will help prevent outages by hardening the lines. This is a proven technique that we already use and are ready to expand. We will use overhead spacer cable technique in many of these locations and are also looking at targeted undergrounding in specific locations for main line feeders, particularly where ledge is limited, there are few customer interconnections, and there is a heavy tree canopy.

Q23. What about the remaining lines in Zones 1 and 2; how will the Zero Outages Initiative improve these lines?

A23. Apart from the mainline feeder work described above, work in Zones 1 and 2 will involve mainly overhead tree wire and spacer cable upgrades, particularly in three-phase areas wherever overhead service remains cost-effective and appropriate. In areas where undergrounding is possible, we would utilize undergrounding with above-ground takeoffs

or a mix of undergrounding and overhead combined to help eliminate, where possible, overhead maintenance and hazards.

Q24. What about Zone 3, what is contemplated for these lines?

A24. These typically single-phase distribution lines will be moved to underground wherever possible, with overhead storm hardening where underground is not possible. We estimate the need to address over 3,500 miles by 2030. Thanks to construction innovations, the installation cost of cable-in-conduit undergrounding is comparable in cost to the installation of overhead hardening in many areas, as long as we continue to avoid undergrounding where ledge and blasting are required. And this does not even account for the better lifetime maintenance costs of undergrounding compared to overhead repairs. It is important to note that this underground work will focus on the primary lines, not the service lines to individual homes. Underground cable in conduit is stable and can withstand many grid impacts, even flooding. In the July flooding, underground cable in conduit in one area where the road washed out stayed in place and kept the power on. And, as described by Mr. Castonguay, these areas also may be tied into microgrids in certain locations to further enhance resilience.

Q25. What do you expect will be deployed to increase resilience for GMP's most rural customers in Zone 4?

A25. To reach zero customer outages in our most rural locations with the fewest customers, we expect to use solutions beyond traditional poles and wire upgrades. We know that for many of these customers, individual residential storage solutions will be more cost effective now than the available storm hardening techniques, particularly when the

multiple benefits of storage for those customers and the grid are considered. For those customers, we expect to offer customer storage solutions similar to our ongoing Grafton pilot, as further described by Mr. Castonguay. Storage solutions deployed at individual customer locations will allow these customers to remain powered up while we address system outages, so that from a customer perspective, no outages are experienced even in these rural circuits.

Q26. Have you analyzed what this zone approach looks like in practice on GMP's distribution circuits?

A26. Yes, we have already specifically analyzed how it will apply to one of our longest, most rural circuits that has recently been hit with nearly all of the major storms this past year: Our East Jamaica circuit that feeds portions of Jamaica, Townsend, Wardsboro, Newfane, and Dover. **Exhibit GMP-MB-8** illustrates this approach on that circuit, summarizing the number of miles in each zone within the circuit using the zones breakdown discussed above. This helps us plan how much T&D storm hardening will be accomplished in each zone in these communities, with many of these projects already underway. It also shows how many customers are in Zone 4 where for many, storage will be the preferred solution.

Looking at the zones and outage history on this circuit clearly illustrates why what we are seeking in this filing is needed. The East Jamaica circuit is 196 miles of line and serves approximately 2,640 separate customer locations. For comparison, the 19-G7 circuit in Essex, Vermont—where there are very few outages because of the more urban, less forested character and the hardened infrastructure already in place—is only 22 miles

of line and serves about 2,700 customer locations, slightly more customer than the East Jamaica circuit. What this means is that customers in East Jamaica live spread out across miles and miles of that rural circuit and are much more exposed to the damage severe weather brings to our forested, mountainous communities than the same number of customers in Essex. With the solutions we know work now, we can address this inequity while lowering costs for all customers across the state.

To provide another example of this type of analysis, **Exhibit GMP-MB-9** shows the same treatment of the BE-G28 circuit in Bethel, a circuit that we applied for federal grant funds to help make Bethel a zero outages circuit, as Mr. Castonguay describes further in his testimony. We will use different techniques across Zones 1 to 4 in Bethel, including overhead storm hardening, automated technology, undergrounding, a community microgrid and customer-sited energy storage.

Q27. How will the Zero Outages Initiative investment you are planning for T&D relate to the capital investment and resiliency work already authorized under the MYRP?

A27. We will do as much work as possible under our existing MYRP—for example, the accelerated projects we are deploying right now before next winter—without impacting other core capital priorities over the four-year MYRP. While the MYRP gives us flexibility in year-to-year spending variation, the overall cap of ~$119M per year for all projects including T&D will not accomplish the level of project deployment needed to create a fully resilient system for customers. We are seeking to accomplish accelerated and additional work, prioritized as described above, under the strategic exception provision of the MYRP. We need to deliver more T&D solutions more quickly over the

remaining years of the MYRP, FY25 and FY26, up to an additional $250M total. We will not seek to include these projects in rates until they are completed and performing for customers, as described in more detail in the testimony of Ms. Doane and the accompanying proposed accounting plan for this work. The same treatment applies to the additional energy storage solution funding we seek of up to $30M over these two years, as Mr. Castonguay describes. We expect to incorporate this work into our next IRP (December 2024) as we scale up and will include the following years of investment in our next full rate case and any successor regulation plans, which we expect to cover FY27 to FY30.

Q28. How did you estimate the investment level requested in this filing for the accelerated T&D work in the Zero Outages Initiative and what will it take to accomplish that?

A28. For the final two years of the MYRP, we expect to be able to complete, based on ramping up available resources, managing lead time material ordering, and seeking necessary permitting, up to an additional $250M (roughly $125M/year) in T&D Zero Outages Initiative investments beyond the work we are already doing. This will require a ramp up of external resources from contract crews as well as local in-state excavators and will allow us to deliver many more miles of undergrounded and hardened infrastructure than we can currently accomplish, as described above. We are also already working with our material suppliers to make sure supply can meet the increased demand of this resiliency work, cost effectively.

We will keep ramping up the pace of the work, as we secure equipment and materials, manage deployment of personnel and contractors, and incorporate innovative

technology and techniques. As we implement projects in these next two years, we will continue to refine estimates for the required trajectory in the subsequent years to achieve the Zero Outages Initiative.

When considering the necessary additional strategic capital investment, it is important to remember the pace and impact of restoration costs that would occur without these resiliency improvements, as the storm impacts from climate change will only intensify, along with the impact on Vermonters if these investments are not made. These are important long-lived assets when added to the cost of service, thereby having manageable annual impacts, as noted above. By establishing the process by which GMP must deliver these projects for customers, over and above currently approved investments, and then seeking rate treatment only after they are completed and submitted for review, we can deliver on this work, show what we can accomplish for customers in a just and equitable manner, and ensure customers only see in rates projects that are over and above the current MYRP limits.

Q29. Why is it critical to deliver the benefits of this accelerated reliability and resilience work now?

A29. Our customers and teammates cannot continue to go through a winter, or summer, like we just experienced. The importance of this work goes well beyond simply reducing the number of outages we must respond to for customers during the next storm or the many that will hit after that. With the Zero Outages Initiative, we will have a connected, coordinated grid that reduces not only response costs, by allowing our restoration work when needed to be more efficient and dynamic, but also our power supply and

transmission costs because this work will further allow us to manage loads locally and provide customers with clean electricity at all times of the year through a variety of distributed and regional resources, enabled by customer-sited and utility scale storage.

We know that these projects help the grid withstand the forces of more severe weather, thereby leading to fewer outages and quicker recovery times for customers. They enhance safety because hardened infrastructure will require fewer repairs, thereby decreasing the risk to crew and enhancing the safety of the communities we serve. We also can expect long-term savings through the reduced need for outage repairs; given the size of storm repair costs due to extreme weather over recent years, this is a substantial value to customers. We are also confident that the strategies listed here for the Zero Outages Initiative bring energy equity in terms of how we deliver service to all customers.

The value of resilience goes beyond simple calculations, especially because the value of avoiding outages will protect the health and safety of customers and their families. In the storms this past winter, many communities lacked centralized places to serve those in need, and some customers could not use that option even if it existed because they were not even able to get out of their homes due to 48” of snow against their doors. Formulaic cost-benefit analysis and traditional tools like the Interruption Cost Estimate (ICE) method that attempts to place a system value on doing a project now

versus deferring the project is highly inadequate and unsatisfactory for this work, as we described in the Climate Plan proceeding.[8]

Ultimately, the need for this work is shown clearly by the impacts GMP customers and others have already seen from climate change-driven storms. The risk in a small, rural state like Vermont is not that we will go too fast or accomplish too many projects, but that we will not be able to move fast enough to meet the greatest challenge of our time. That is why we ask that the Commission approve this framework to allow us to increase capital investment for this work now.

Q30. Does this conclude your testimony at this time?

A30. Yes, it does.

[8] See Prefiled Direct Testimony of Michael Burke, filed January 30, 2020, in Case No. 20-0276-PET, at 28.

I, Michael Burke, declare that the above statements provided in my testimony are true and accurate to the best of my knowledge and belief. I understand that if the above statement is false, I may be subject to sanctions by the Commission pursuant to 30 V.S.A. § 30.

Dated at Colchester, Vermont this 9th day of October 2023.

Michael Burke