TC Review on the Viability of Embedded Generators (EG) as Emergency Power Supply in Highly Urbanized Area

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This Report is prepared by the
WESM Technical Committee

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1.0 INTRODUCTION

The Philippines is susceptible to natural hazards[1] due to its geographical location. It is a known fact that when calamities like typhoon and earthquake hit certain areas, major lifelines[2] such as electricity supply are greatly affected. In 2020, Taal Volcano erupted which caused volcanic earthquakes and affected nearby areas. A total of 24 municipalities experienced power interruption due to the ash fall which caused multiple circuits to trip due to line fault. With this event, about 4,000 MW of power supply which is intended for Metro Manila and nearby provinces was threatened since power plants providing this capacity is situated within the 14-kilometer danger zone of Taal Volcano[3].

In 2021, the Philippines was hit by five[4] (5) typhoons with Typhoon Odette considered as the strongest typhoon that year. For Typhoon Odette alone, 428[5] municipalities experienced major interruption on their power supply some lasted for almost three months.

Noting the challenges in the energy sector brought about by previous calamities, the WESM Technical Committee (TC), upon the instruction of the Office of the Chief Governance Officer (OCGO), conducted this review to determine the viability of embedded generators (EG) in providing emergency power supply in calamity-prone areas specifically the highly urbanized areas.

2.0 PURPOSE OF THE DOCUMENT

This report provides the TC's insights on the viability of using EG as emergency power supply in calamity-prone areas specifically highly urbanized areas.

3.0 ENERGY RESILIENCY IN THE PHILIPPINES

Resiliency[6] is defined as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely manner, including through the preservation and restoration of its essential basic structures. With the Philippines exposed to natural hazards such as earthquakes and tropical cyclones, among others, energy resiliency plays an important role in ensuring that such hazards would not have a huge impact on the country's economy and the people's daily life.

In a Department Circular (DC) issued by the Department of Energy (DOE), DC No. 2018-01-0001, the DOE provided a resiliency program in planning, project implementation and operations of the energy

[1] Natural Hazards can be divided into rapid onset hazards, such as Volcanic Eruptions, Earthquakes, Flash floods, Landslides, Severe Thunderstorms, Lightening, and wildfires, which develop with little warning and strike rapidly.
[2] Department Order No. 2018-10-0017, Management Responses During Emergencies and Disasters, DOE, 2018
[3] Philippine Energy Plan 2020-2040, Department of Energy (DOE), 2020
[4] 2021 Tropical Cyclones Track, PAGASA, https://www.pagasa.dost.gov.ph/information/about-tropical-cyclone
[5] Typhoon Odette Final Report, National Disaster Risk Reduction and Management Council (NDRRMC), 31 March 2022
[6] Department Circular No. 2018-01-0001, Adoption of Energy Resiliency in the Planning and Programming of the Energy Sector to Mitigate Potential Impacts of Disasters, Department of Energy (DOE), 17 January 2018

supply sector. In the published DC, the DOE laid out the following general policies and principles[7] in achieving a resilient energy industry:

1. Strengthen existing infrastructure facilities to adapt to and withstand adverse conditions and disruptive events;
2. Incorporate mitigation improvements into the reconstruction and rehabilitation of infrastructure damaged in accordance with the Build Back Better[8] principle;
3. Improve operational and maintenance standards and practices to ensure expeditious restoration of energy supply in the aftermath of disruptive events; and
4. Develop resiliency standards for future construction of facilities to ensure minimal damage and adoption of measures in place for time recovery and restoration of facilities for the continued delivery of supply.

The initial response during calamities starts with the protection and restoration of local/distribution network. Hence, strengthening the distribution infrastructures is one of the key considerations in the preparation of a Resiliency Compliance Plan (RCP) by the energy industry participants. The DOE, alongside the National Electrification Administration (NEA), supervises and facilitates the timely preparation and submission of RCP of all Distribution Utilities (DU) to meet the resiliency goals of the country for the distribution sector, as provided under the Energy Resiliency Policy[9].

Another preventive measure in addressing power supply issues during calamities is to have a self-sufficient network. In Thailand, an example of an energy resilient community is Pa Deng – a community located inside Thailand's oldest and biggest national park[10]. In this community, individual households would source their electricity from their solar home systems and their energy-for-cooking needs from biogas digesters noting that some households do not have access to grid-based electricity as prohibited by their state law[11].

For distribution networks, the use of EGs as backup generators during emergencies and calamities can be one of the solutions in mitigating future electricity supply problems. This is supported by a memorandum[12] issued by NEA which encourages the electric cooperatives (ECs) to invest in embedded power generation projects to serve as reserve or backup power to consumers during emergencies and calamities.

Another option is the use of distributed energy resources (DER) since DER systems offer consumers energy independence. DER are also considered as EG since they are connected within the electric distribution system. However, in terms of size, DER are smaller electric generation units located at or near the end user[13]. Some of the applications[14] of DER are as follows:

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[7] DC No. 2018-01-001, DOE, January 2018
[8] "Build Back Better" – the use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment.
[9] Philippine Energy Plan 2020-2040, Department of Energy (DOE), 2020
[10] Delina, L., Ocon, J., Esparcia, E. Jr., What makes energy systems in climate-vulnerable islands resilient? Insights from the Philippines and Thailand, Energy Research and Social Science, Elsevier, July 2020
[11] Ibid, 3
[12] NEA urges electric coops to invest in embedded power generation, NEA, June 2021, https://www.nea.gov.ph/ao39/678-nea-urges-electric-coops-to-invest-in-embedded-power-generation
[13] Capehart, B., Distributed Energy Resources (DER), University of Florida, October 2016, https://www.wbdg.org/resources/distributed-energy-resources-der
[14] Capehart, B., Distributed Energy Resources (DER), University of Florida, October 2016, https://www.wbdg.org/resources/distributed-energy-resources-der

1. Hospitals - require high reliability (back-up power) and power quality due to the sensitivity of equipment.
2. Industrial plants - to lower cost of energy considering the amount and duration of works they require.
3. Data Centers - require steady, high-quality, uninterrupted power.

4.0 EMBEDDED GENERATION AS EMERGENCY POWER SUPPLY

As defined in the WESM Rules, embedded generators are generating units that are indirectly connected to the Grid through the DU's lines or industrial generation facilities that are synchronized with the Grid. Aside from providing power within the DU network, EGs are allowed to provide electricity to the grid and Ancillary Services as stated in the DOE Circular No. DOE DC 2019-02-003[15].

Before the issuance of the abovementioned DC, the Mindanao ECs are already utilizing embedded generation to address the supply shortage which are essential in maintaining power quality and the reliability of the grid. In addition, EGs in Mindanao were used to provide emergency power particularly on facilities and establishments that require highly reliable electricity[16].

Noting that EGs have the capability to provide backup power as long as they operate within the operational requirements prescribed in the Philippine Grid Code (PGC) and Philippine Distribution Code (PDC), the question that needs to be addressed is that if it is viable to use EG as backup generator during emergencies and calamities.

In this regard, the TC believes that the following factors should be considered in using EG as backup power supply:

a. Stationary vs Mobile Embedded Generators which is generally a function of the capacity in MW

   Large EGs are generally stationary while smaller EGs (about 5 MW and below) can be mobile – where those in the upper range require special transport facilities. These are generally diesel- or natural gas-powered. Likewise, transport of fuel especially during emergency is taken into account. Other options for embedded generators may include Variable renewable energy (VRE) resources such as small wind or solar photovoltaics (PV). At low capacities, these are generally quicker to install than traditional alternating current (AC) generators. However, AC converters are needed for such VRE generators.

b. Critical load support vs Network support via distribution facility

   EGs are installed either to meet critical local loads or to support the demands of the network. During emergencies, critical loads such as hospitals or data centers will still be prioritized in terms of support. However, those for network support may supply portions of the network depending on the availability of distribution facilities. Local utility may be able to source from these, but such emergency operation requires specialized protection and control schemes that are facilitated by qualified technical personnel for safety and reliability. This is imperative even in deploying mobile

[15] Department Circular No. 2019-02-003, Providing for the Framework Governing the Operations of Embedded Generators, Department of Energy (DOE), February 2019

[16] Phoumin, H., et. al.,Chapter 5: Distributed Energy System in the Philippines, Distributed Energy in Southeast Asia, Economic Research Institute for ASEAN and East Asia, 10 September 2018

EGs to supply the network. As such, the local utility should be involved in assessing various options for sourcing power from either stationary or mobile EG when distribution facilities are employed.

5.0 DISASTER RESPONSE IN THE PHILIPPINES

During natural hazard, three main types of incidents can lead to system breakdowns: transmission and distribution grid failure, generation plant failure, and fuel and maintenance supply chain failures[17]. These incidents should be considered in creating disaster recovery responses.

For "The Big One", a magnitude 7.2 earthquake from the West Valley Fault, the DOE prepared the National Energy Contingency Plan (NECP). The plan specifies responses and early recovery measures to provide the following:

a. Emergency response and the immediate restoration of power services for pre-determined critical facilities;
b. Strategic allocation and rationing of petroleum products for disaster response and critical activities; and
c. Requirements for the rehabilitation and recovery of energy services.

It can be observed that disaster response activities are focused on the restoration works of facilities such as transmission and distribution lines. This can be further inferred from the information in Table 1 which provides the response activities of various organizations to restore power outage during calamities that struck the Philippines in 2020:

Table 1. Response Activities to various Calamities in 2020[18]

	Calamity	Response Activity
1	Typhoon Quinta (2020)	• Emergency restoration commenced immediately after passage of typhoon in affected transmission and distribution lines, and facilities of the National Power Corporation-Small Power Utilities Group (NPC-SPUG) • Power restoration teams were organized for the quick restoration of transmission and distribution lines in the affected areas.
2	Typhoon Rolly (2020)	• The Task Force on Energy Resiliency (TFER) Chairperson visited Catanduanes to assess the energy situation and address pressing concerns. • NEA in cooperation with the Philippine Rural Electric Cooperative Association, Inc. (PHILRECA) assisted the restoration works of affected facilities (transmission and distribution lines)
3	Typhoon Ulysses (2020)	• NEA in cooperation with PHILRECA assisted in the power restoration in the Bicol Region • NPC-SPUG initiated the power restoration works in Catanduanes including the provision of two (2) generators sets.

[17] Nicolas, C. et al., Stronger Power: Improving Power Sector Resilience to Natural Hazards, World Bank Group, 2019
[18] Philippine Energy Plan 2020-2040, Department of Energy (DOE), 2020

<u>Highly Urbanized Area</u>

As defined by the Bureau of Local Health Development (BLHD), an area is considered a highly urbanized when it has: (1) a minimum population of 200,000 inhabitants, as certified by the National Statistics Office (NSO); and (2) the latest annual income of at least 50 million pesos based on 1991 constant prices, as certified by the city treasurer.

As of 2021[19], the Philippines has 33 highly urbanized cities (HUCs), 16 of which are in the National Capital Region (NCR), while 17 are outside the NCR. Noting the number of inhabitants and the annual income of these areas, it is safe to assume that various industries will be affected if power supply on these cities are interrupted due to natural disasters.

For Cebu alone, which was greatly hit by Typhoon Odette in 2021, rehabilitation works on damaged distribution lines were still ongoing for several ECs a month after the onslaught of the typhoon[20]. Some of the reasons as regards the delay in the reconnection of power is on the damage to properties, construction and repairs, and service entrance problems among others. Power interruption in the area also affected the supply of water and communication system.

It is important to note, that transmission and distribution grid failure contributes to most power outages during calamities since they are more vulnerable to natural disasters. Hence, the use of EGs as backup power generator is useful if they are accessible and transportable.

In any given area, whether highly urbanized or not, the prerequisite could be all critical installations in any establishments, whether government or private related, should have a self-sufficient power supply or should at least be capable of operating up to some extent even with reduce operation, during emergencies without relying to external source. Having an EG for emergency response in highly urbanized area requires either having enough wires to transmit power there or enough transport facilities to mobilize the equipment.

6.0 CONCLUSION

Adopting the disaster resiliency and contingency plans of the DOE, which include the development programs for strengthening existing infrastructure facilities, is crucial in emergency preparedness, disaster mitigation and damage restoration during natural calamities.

The TC has a very limited knowledge and experience in disaster risk management. However, based on its assessment, the viability of EGs as emergency power supply during periods of natural calamities should consider the following factors:

- Relative Location – the distance between the EG from the disaster area should be close enough to allow the transport of equipment and supplies or delivery of power over short distance. However, the distance should also consider the radius of the disaster area which may adversely affect the generator operation.

[19] 2021 Rankings of Highly Urbanized Cities, Department of Trade and Industry (DTI), https://cmci.dti.gov.ph/rankings-data.php?unit=Highly%20Urbanized%20Cities
[20] Cebu: A month after Odette's fury, Cebu Daily News, https://cebudailynews.inquirer.net/420593/odette-cebu-one-month-later

- Transportability and Logistics – if the EG is transportable, safe access to the disaster area should be determined for transport of equipment and fuel supplies as well as suitable site for operations.
- Electrical Networks – if the EG is stationary, the conditions of distribution and transmission networks intended for power delivery should be determined for safety and reliability.
- Operational Safety – operating generating equipment and high voltage networks requires qualified technical personnel for safety and reliability.

The TC acknowledges the fact that the range of disasters that may result in different natural calamities are difficult to predict and the best laid plans for risk mitigation may not always be adequate. However, it shares the belief with the DOE and the government that emergency preparedness is our best defense.

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