Generator Technical Review

This job aid supplement covers the requirements associated with the technical reviews for generator projects funded by Hazard Mitigation Assistance. FEMA will also conduct an Environmental Planning and Historic Preservation review of each project. Refer to the Generator: Information Required for Environmental Review Job Aid.

This Technical Review Supplement provides additional information, examples and potential sources of documentation for items listed in the Generator Job Aid to help communities applying for Hazard Mitigation Assistance grants comply with application requirements.

- All Hazard Mitigation Assistance (HMA) applications must comply with the requirements outlined in the HMA Guidance.
- According to the guidance, in addition to a general programmatic review, an EHP review and a technical review will be performed by FEMA for each proposed project.
- The technical review will verify that a project demonstrates feasibility, effectiveness and cost-effectiveness. This document is intended for technical reviews of applications only.
- For assistance completing EHP compliance reviews, see the EHP Supplemental Job Aids.

Introduction

The following provides a review of the information that should be provided with the grant application, including recommended documentation and a list of supplementary information, to assist FEMA when conducting technical reviews of the project application. Technical resources are identified throughout this supplement to provide clarifying information on specific project application components. The final section provides a comprehensive list of resources identified throughout this supplement.

The project-specific guidance in this supplement does not provide all the information necessary to apply for funding through an HMA program and must be read in conjunction with all other relevant guidance documents.

Additional Resources

- Hazard Mitigation Assistance Guidance (HMA Guidance)
- Hazard Mitigation Assistance Guidance Addendum
- Benefit-Cost Analysis Reference Guide and Supplement to the Benefit-Cost Analysis Reference Guide
- Eligibility of Generators as a Fundable Project by the Hazard Mitigation Grant Program and Pre-Disaster Mitigation Program

A list of all resources referenced is provided on the last page of the supplement.

Summary of Steps

- ☐ STEP 1: Provide a Scope of Work
- ☐ STEP 2: Provide Available Technical Data
- ☐ STEP 3: Provide Critical Facility Information
- ☐ STEP 4: Provide a Project Schedule
- ☐ STEP 5: Provide a Project Cost Estimate
- ☐ STEP 6: Provide a Project Site Map
- ☐ STEP 7: Provide Property Location Information
- ☐ STEP 8: Determine if Project Location is in a Floodplain
- ☐ STEP 9: Document the Risk to be Mitigated
- ☐ STEP 10: Cost-Effectiveness Analysis
- ☐ STEP 11: Environmental and Historic Preservation Considerations

Important Terms

5% Initiative: Allows grantees under the Hazard Mitigation Grant Program (HMGP) to use up to 5% of the total HMGP grant funds for projects that are difficult to evaluate using FEMA-approved cost-effectiveness methodologies, but which otherwise meet HMGP eligibility requirements. To demonstrate cost-effectiveness under the 5% Initiative, applicants must provide a narrative description of the project's cost-effectiveness in lieu of a standard FEMA benefit-cost analysis (BCA).

Critical Facilities: Structures and institutions that are deemed by the local community and other jurisdictions as critical to the continuity of the community before, during and after an event. Although the affected jurisdiction has the primary responsibility for determining what structures and institutions are critical facilities, FEMA reserves the right to make a final determination as needed to support the review and approval of an HMA project application.

Fixed Generator: Also referred to as a standby generator, a fixed generator is a permanently installed generator that provides power by being hard-wired into the facility's main distribution panel and can be started manually or automatically in the event of a power outage. During a power failure, an automatic transfer switch isolates the electrical wiring from the utility grid and signals the generator to start functioning. The generator begins to feed power to the lines. When power is restored, a reverse action takes place, wherein incoming feed is once again procured from utility lines and the generator ceases to function and goes into a standby mode.

Generators: Emergency equipment that provide a secondary source of power. Generators and related equipment (e.g., hookups) are eligible provided they are cost-effective, contribute to a long-term solution to the problem they are intended to address and meet other program eligibility criteria.

Generator Hookup: Provide a pre-installed connection for a portable generator to be connected to the facility's electrical system quickly, when needed.

Portable Generator: Work with stand-alone applications and are meant to temporarily energize a few critical applications vis external cords. These are usually functional for a brief period. Different models of portable units can be fueled using one or more specific energy sources like gasoline, diesel, biodiesel, propane or natural gas.

Transfer Switch: Safely connects standby or emergency generators to the electrical system. There are two types of transfer switches: manual and automatic.

Manual Transfer Switch: Requires the presence of an operator to manually change the power source from the primary power source, typically the utility, to the generator.

Automatic Transfer Switch: Continuously monitors fluctuations in voltage and frequency of the utility power and seamlessly changes the power supply from the utility to the generator.

Technical Review Components

To complete a successful project application, a minimum amount of technical information is required for review. The following is a step-by-step approach addressing the major components of a generator project. Data collected in these steps will provide reviewers with the necessary information to determine whether a project is feasible and effective. The data requirements in the following steps should be compiled in an attachment to the project application. If the project impacts multiple structures, this information must be provided for each.

Stand-alone generators (including related equipment) are eligible for Hazard Mitigation Grant Program (HMGP) and Building Resilient Infrastructure and Communities (BRIC) funding if the generator protects a critical facility and meets all other program eligibility criteria. Generators (including related equipment) that constitute a functional portion of an otherwise eligible mitigation measure are eligible for HMGP and BRIC funding. Stand-alone generators and related equipment (e.g., generator hookups) are also eligible under the 5% Initiative (HMGP only). ***This job aid focuses on stand-alone generator projects that are not 5% Initiative projects. If an applicant is preparing a generator application for a 5% Initiative project, the steps related to critical facilities and BCA can be skipped.***

STEP 1: Provide a Scope of Work

Description: Provide a project narrative identifying the proposed mitigation action and facilities requesting backup power, including a description of the proposed activities and an explanation of how the project will mitigate risk. The SOW should include key milestones and correspond with the design information, tasks required to properly implement emergency standby power, project schedule and cost estimate.

References: When preparing the SOW, refer to the following:

- HMA Guidance Part IV, Section H: Scoping Narrative: Scope of Work, Schedule, and Cost Estimate

Approach: A licensed engineer or contractor may need to be consulted when developing the SOW for the mitigation project. The following items are recommended for inclusion in the SOW; specific details and documentation to support the narrative will be included in the subsequent steps:

- Provide a detailed narrative of the risk being mitigated, including information of related damages and power outages for the facility, if available.
- Explain how the generator protects and/or reduces loss of function to a critical facility. Per the FEMA HMA Guidance definition, critical facilities are:
  - Structures and institutions necessary, in the community’s opinion, for response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery. These would include, but not be limited to:

    - Structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic and/or chemically reactive materials
    - Hospitals, nursing homes and housing likely to have occupants who may not be sufficiently mobile and avoid injury or death during an emergency
    - Police stations, fire stations, vehicle and equipment storage facilities and emergency operations centers that are needed for emergency response activities before, during and after the event
    - Public and private utility facilities that are vital to maintaining or restoring normal services to affected areas before, during and after the event
- Other structures or facilities the community identifies as meeting the general criteria above
- Describe the sizing of the generator, fuel supply and fuel storage capacity.
  - The generator's size and specifications should be reasonable, appropriate and necessary to continuing critical functions of the facility; ideally an electrical load capacity analysis should be completed based on the critical functions the generator will power.
  - Generator size will vary by facility and usage. It is not always necessary for the generator to support the full capacity of facility operations, but it should be sized appropriately such that the facility is able to provide uninterrupted critical functions in the event of future power outages.
  - The fuel type and storage capacity must be sufficient to mitigate risk from the hazard(s). If fuel is stored on-site, clarify how long the fuel is expected to operate the generator and how the generator will be refueled during future long-duration power outage(s).
- Explain where the generator will be in the critical facility.
- Define the level of protection the mitigation will provide. For example, "the generator will be elevated above the 500-year flood event elevation and anchored per the ASCE 7 requirements for wind design, enabling the hospital's functions to remain operational during a 500-year flood or high-wind event." The generator location, and possibly enclosure, should consider multiple hazards, including windborne debris and flooding.
- Verify that the project will be constructed to the latest edition of codes and standards by including a description of the building code and standards that are to be followed.
- Mitigation project alternatives are required as part of the application development (e.g., different alternate standby power source, fuel type, automatic versus manual transfer switch, etc.). Document at least two alternatives that were considered during the planning or design phase. Clearly indicate which alternative is the preferred mitigation alternative and discuss why it is the most practical, effective and environmentally sound alternative. One alternative is often considered the "no-action alternative" and reflects conditions expected to exist if a mitigation project is not completed. This is a key step to verify an efficient EHP review process.
- Explain the proposed mitigation activity, specifying the deliverables, identifying the tasks required to complete the proposed activity and defining the tasks to be accomplished in clear, concise and meaningful terms. All cost elements must match tasks and provide sufficient detail for FEMA to determine whether the application is eligible. The scoping narrative will become part of the conditions of the award.

STEP 2: Provide Available Technical Data

Description: It is necessary to demonstrate that a project is feasible and effective at reducing risk. Provide engineering or design plans showing the generator interconnections; these may be conceptual (e.g., sketches or schematics) with the project application. This information can be further developed following the grant award and should be accounted for in the scoping narrative, schedule and cost estimate if not available during application development.

Approach: Project plans should comply with the applicable codes, standards and minimum construction requirements. Providing project plans and specifications will allow reviewers to determine the technical feasibility for the proposed mitigation project and check the validity of the cost estimate against the drawings and specifications. Document how the scope solves the identified hazard risk or is a **functional portion of a solution**. The assistance of a licensed engineer or contractor may be required to help obtain the necessary information about mitigation materials. Documentation should indicate that the final design drawings and specifications will be signed and sealed by a professional engineer licensed in the state or jurisdiction where the project is located prior to beginning construction. The following provides general descriptions of generator project types, and the supporting technical information that must be included in the application.

A project represents a **functional portion of a solution** if it produces quantifiable benefits shown through an approved BCA methodology.

- A **fixed generator** as a stand-alone project that can be considered under HMGP and BRIC funding if the generator protects a critical facility. A generator that is a component of a larger project (e.g., elevation of a lift station) can also be funded under the HMGP and BRIC, and aggregation of the BCA is permitted.
    - Permanently installed generators are recommended for critical facilities but not required. Having any working generator can be helpful during an emergency because it assists in maintaining necessary, and potentially, critical operations.
    - The generator may be connected with an automatic or manual transfer switch (described below), depending on the needs of the facility. The after-mitigation level of effectiveness may vary based on whether the transfer switch is automatic or manual; in addition, the electrical code requires an automatic transfer switch for certain functions.
    - The generator should be in a safe and accessible location that is pre-wired (or permanently wired) with connections for the generator, which can save valuable time during an emergency.
    - Fixed generators are generally available in larger sizes than portable generators and usually at higher cost. Additionally, large, fixed generators (750 kW and above) often must be towed and/or hoisted into position and can be difficult to move in places with limited accessibility.
- **Portable generators** are eligible if they meet all HMGP requirements as described in 44 Code of Federal Regulations (CFR) Part 206.464. Portable generator projects that cannot be determined to be cost-effective via standard HMA benefit-cost methodology may still be eligible under the 5% Initiative (provided it can be demonstrated that the proposal would not otherwise fail a BCA).
    - The applicant must provide assurance that the quantity of portable generators will be readily available to protect the functions of the facility(ies) specified in the application. The proposal should describe

transport, hookup, fuel supply and storage requirements at multiple facilities and how these will be executed if the generator is portable.

- A portable generator may be more efficient if only a few vital electrical items need power as portable generators are less expensive than fixed. For example, a portable generator is more applicable if there are multiple lift station gates that need to be opened individually but do not require continuous power.

- **Generator hookups:** Permanently installed generator connections that can receive power from a portable generator are cost-effective alternatives to fixed units. The benefit of this approach is flexibility. During an emergency, a single generator could be moved into position, connected and used as needed; when the need is met, it can be moved to the next position and the steps repeated.
- **Transfer switches** are devices that safely connect standby or emergency generators to the electrical system. There are two types of transfer switches:
  - **Manual transfer switches** are used to transfer power between the utility and portable or operational standby generators. Manual transfer switches must be operated manually when utility power is lost and when it is restored. The switches can be wired to a separate subpanel to run essential circuits in the building, such as lights, or they can be wired to run the entire building if the attached generator is sufficiently sized. Manual transfer switches are commonly used when a portable generator system is involved but may be used with fixed generators.
  - **Automatic transfer switches** automatically start the generator and provide power from the generator to the facility when they detect a loss of utility power. They also retransfer the facility back to the utility when the utility power is restored and will shut down the generator. Automatic transfer switches are typically only used with fixed generators. It is recommended that the applicant discuss their needs with a licensed electrician or a licensed electrical engineer to determine which type of transfer switch would be better suited for each individual project.
- **Single-phase power** and **three-phase power**:
  - **Single-phase:** The standby generator for a facility must supply the same type of power and match the voltage and phase configuration that the electric utility company supplies to the facility. For a smaller facility, this typically means single-phase power at 120 and 240 volts. This requires four wires: two phase wires, one neutral wire and one ground wire.
  - **Three-phase:** Depending on the type of facility, there might be a need for three-phase power. Large motors require three-phase power and often are used for commercial refrigeration and air cooling and handling and to operate heavy machines. Typical voltages for three-phase power include 102/208V and 277/480V. Three-phase generators are often required at larger facilities that are supplied three-phase power by the utility. Some facilities may require higher voltages that can be supplied by larger three-phase standby generators. Some installations may require transformers and other equipment to change the voltage to the facility's requirements. Three-phase generators supply power with three or four wires (plus one ground wire); three wires carry the three-phase power, an as-needed fourth neutral wire and a ground wire. Many code jurisdictions require an engineering plan for commercial applications before permits are issues, and some also require a licensed engineer's supervision during installation.
- **Sizing** will vary depending on the usage and type of facility. A local shelter that would house displaced members in a community during an emergency would be different than a local fire house that needs a

generator to assist in an emergency to operate the doors. It may not be necessary for the generator to support the facility at full capacity but should be sized to support the critical functions of the facility. Determining what facility functions the generator needs to support is crucial in selecting the correct generator for the facility. The rated output of the selected generator must be matched to the maximum anticipated capacity needed. To allow the reviewer to determine the technical feasibility of the application, the applicant shall prepare a load list to determine the electrical needs of the facility and list what equipment will be needed to be powered by the generator during an emergency. The starting and running power of the facility loads are needed to determine the size of the generator. Additionally, large motors such as those used in refrigeration and HVAC typically require additional "starting" capacity when first started. Most major generator manufacturer's provide free online software that the applicant can utilize to analyze the facility loads and determine the appropriate generator size. It is also recommended to consult an electrician or a licensed engineer to help determine the size needed to allow the facility to function during an emergency.

- **Site determination:** Determining a site for the generator is important. It should be close enough to the facility that it is easily accessible. This will also reduce the installation cost because less material will be used to hook up the generator to the facility and power loss between the generator and the building will be minimized. The selected site should not be in a Special Flood Hazard Area, or if no feasible alternative exists, the generator must be elevated to a height at or above the 500-year anticipated flood elevation and must comply with the community's floodplain management ordinance. Additionally, the selected site should provide sufficient space to maintain and fuel the generator and must meet the National Electrical Code working clearance requirements.
- **Generator enclosure:** Outdoor generators are available with multiple types of enclosures. The selected enclosure must be rated for the environment in which it will be installed and shall meet the applicable installation codes and standards for wind resistance, seismic requirements and sound attenuation details.

STEP 3: Provide Critical Facility Information

Description: It is necessary to demonstrate that a project is feasible and effective at reducing risk. As part of this demonstration, provide detailed information about the critical facility that the generator will be powering.

Approach: Provide the following information about the building or structure the generator will be powering:

- Date structure was built
- Building type (e.g., hospital, school, pump station)
- Construction type, if applicable (e.g., wood framed, masonry/brick, concrete, steel)
- Additional details related to the existing condition of the structure
- Contents of the building and function (e.g., fire station, emergency operations center, shelter, radio communication equipment)
- Describe the critical services or functions that the facility provides to justify its characterization as critical
- Quantify the amount of power required to deliver the critical services or functions

Potential Sources: The age of a structure may be verified through city or county property records or from building permit information. This information can often be found from publicly available websites such as the tax assessor website. Some cities and counties have parcel databases with this information. Alternatively, online mapping programs with measuring features and high-quality aerial photographs may be used to estimate the size of the building.

STEP 4: Provide a Project Schedule

Description: Include a detailed project schedule for all tasks identified in the project cost estimate and SOW. The schedule identifies major milestones with start and end dates for each activity. Project schedules must show completion of all activities (including construction period) within the period of performance (POP) allowed by the relevant HMP program. Sufficient detail must be provided so FEMA can determine whether the proposed activities can be accomplished within the POP.

References: HMA Guidance Part VI, Section D.4: Program Period of Performance and Part IV, Section H: Scoping Narrative: Scope of Work, Schedule, and Cost Estimate

Approach: Verify that the information in the schedule supports the SOW and aligns with the project cost estimate.

STEP 5: Provide a Project Cost Estimate

Description: Include a detailed line-item cost estimate for all tasks identified in the project schedule and SOW. All costs included in the application should be reviewed to verify they are necessary, reasonable and allocable consistent with the provisions of 2 CFR Part 200. Include sufficient detail so that FEMA can determine whether costs are reasonable based on proposed activities and the level of effort. Costs incurred prior to award may be considered pre-award costs and may be eligible for reimbursement. Eligibility may depend on the date they occurred and the grant program. Refer to HMA Guidance and the Notice of Funding Opportunity for specifics.

Reference: HMA Guidance Part IV, Section H: Scoping Narrative: Scope or Work, Schedule, and Cost Estimate

Approach: Applications must include detailed, line-item costs in the project cost estimates for each mitigation item provided in the SOW. Well-documented project cost estimates contain quantities, unit costs and a source for each unit cost. Lump sum cost estimates are not acceptable. The cost of generators varies by size, installation and purpose. The generator’s size and specifications should be reasonable, appropriate and necessary to continuing critical functions of the facility. The assistance of a licensed engineer, architect or contractor may be required to help develop the project cost. Where applicable, provide line-item costs using the recommended line items below.

Allowable costs are costs that are necessary and reasonable for the proper and efficient performance and administration of the federal award. They may include, but are not limited to:

- Engineering services for design, structural feasibility analysis and cost estimate preparation
- Project administration and construction management
- Surveying and inspection
- Permitting and/or legal fees
- Disconnecting and reconnecting utilities and extending lines and pipes, as necessary
- Debris disposal and erosion control, if applicable

It is also important to verify that an annual maintenance cost has been determined using appropriate methods. The annual maintenance cost is necessary to address those costs associated with maintaining the effectiveness of the mitigation measures. Although the costs will not be funded by FEMA, they are required to be included in the BCA.

STEP 6: Provide a Project Site Map

Description: Provide a map showing the project location. If the project includes multiple sites, show the project boundaries, including the staging area. **Figure 1** provides an example of a project site map.

Reference: Supplement to the Benefit-Cost Analysis Reference Guide Section 5: Available Technology Aids

Approach: Provide a map showing the project location including structures, flooding source, map scale and location information. For any maps provided, verify that a scale bar is shown and the map if clearly labeled to identify the project boundaries.

Potential Sources: Official site survey, assessor maps and topographic maps obtained from the project engineer or planner, and maps created using a web-based service such as Google Maps

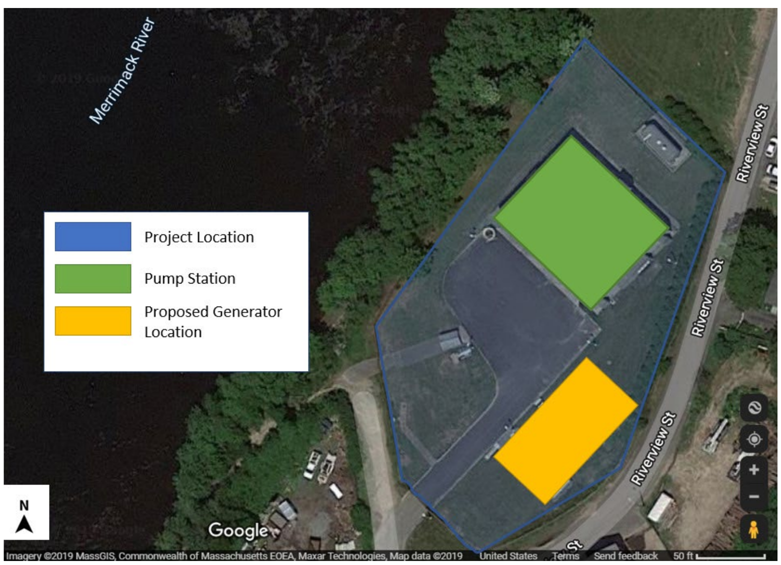

Figure 1. Example of a project site map. Map clearly shows the facility to be mitigated and the project area. The map includes a north arrow and a scale.

STEP 7: Provide Property Location Information: Address and Latitude and Longitude

Description: Provide both the physical address(es) and the latitude and longitude of each critical facility in the project application. For projects with multiple properties, tables containing all relevant information by property can be helpful.

PROPERTY ADDRESS

Approach: Provide property address(es) of each structure where a generator will be installed. This includes street name and number; city, county or parish; state; and zip code. A post office box number is not an acceptable address.

If the address provided does not clearly match up with the structure(s) to be mitigated, provide photos or a site map with the structure(s) footprint(s) clearly identified.

Potential Sources: Property owner, local building inspector, tax assessor records, deed to the property, engineering plans

Example: 1011 Electric Avenue, San Francisco, San Francisco County, CA 94102

LATITUDE AND LONGITUDE

Approach: Provide the latitude and longitude of each structure where a generator will be installed. The latitude and longitude should be taken at the center of the property. The latitude and longitude can be provided in either decimal degrees (e.g., 27.9807, -82.5340) or degrees, minutes and seconds (27° 58' 50.5'' N, 82° 32' 2.4'' W).

Potential Sources:

- GPS device
- Free online map tools or search engines that generate latitude and longitude when an address is supplied

Example: 27.9807, -82.5340 or 27° 58' 50.5'' N, 82° 32' 2.4'' W

STEP 8: Determine if Project Location is in a Floodplain

Description: Provide a Flood Insurance Rate Map (FIRM) showing the project location. Include a description of the flood zone in which the existing structure is located and whether the site is in a regulatory floodway. An example is provided in **Figure 2**.

References: To identify flood risk, refer to FEMA's Flood Map Service Center and FEMA's How to Find Your FIRM and Make a FIRMette.

Example:

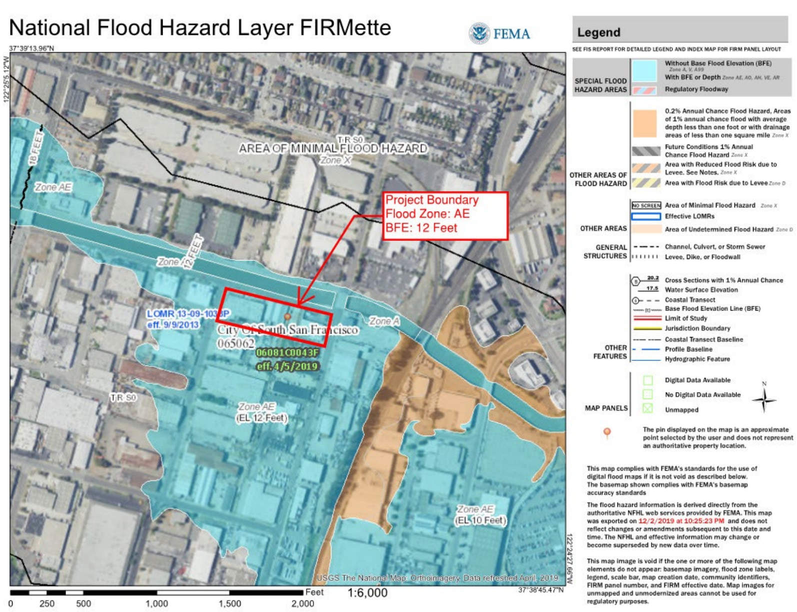

Figure 2. FEMA FIRMette with project boundary identified.

STEP 9: Document the Risk to be Mitigated

Description: Mitigation projects funded under HMGP and BRIC must demonstrate that the proposed mitigation activity will address a problem that has been repetitive or that poses a significant risk to public health and safety if left unresolved. Generator projects must document the risk to the critical facility from natural hazards. Because multiple hazards can disrupt power supply, specify what hazard(s) is causing the loss of power that the generator will mitigate and provide documentation of the hazard's risk. The risk to be mitigated can be based on either documented historical damages (such as loss of function during a previous disaster event) or professionally expected damages (estimated damages that have not yet occurred or that occurred but not to the extent probable for a given event).

Approach: Identify the hazard to be mitigated and document the risk to the facility's power supply from the identified hazard. When identifying the hazard risk, the applicant should be sure to include the following elements:

- **Loss of service history:** provide documentation supporting dates and times (if available) of power utility disruption.
- **Loss of service cause:** provide documentation of the natural hazard event that caused the disruption of power utility (e.g., hurricane winds, flood, seismic events); documentation should include the magnitude or severity of the event (i.e., event wind speed, flood depths, magnitude of seismic event).

Potential Sources:

- Insurance claims, BureauNet information, damage repair records, data from a state/local agency, local government newspaper accounts citing credible sources (other than anecdotal accounts)
- Local power outage information from power company
- Facility maintenance records or an affidavit provided by the maintenance director for the facility stating the period (total time and dates) that the facility was without power
- Supervisory control and data acquisition (SCADA) system record of power loss; generally applicable for public works, such as water or wastewater facilities
- Event wind speed documentation: NOAA Weather Observation Stations
- Flood depth documentation: U.S. Geological Survey (USGS) Flood Event Viewer, USGS National Water Information System stream gauge data

STEP 10: Cost-Effectiveness Analysis

Description: Cost-effectiveness must be demonstrated to obtain FEMA funding. A BCA is a quantitative procedure that assesses the cost-effectiveness of a hazard mitigation measure over the useful life of the project by comparing the potential avoided damages (benefits) associated with the mitigation measure to the cost of a project in current dollars.

FEMA will only consider applications that use a FEMA-approved methodology to demonstrate cost-effectiveness. FEMA provides BCA software that allows participants to calculate a project benefit-cost ratio (BCR). The BCR is a calculation of the project benefits divided by the project costs. Projects for which benefits exceed costs (a BCR of 1.0 or greater) are considered cost-effective. FEMA requires the use of the BCA Tool to verify calculations are consistent with Office of Management and Budget (OMB) Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. The BCA must be performed using the most current version of the BCA Tool. Benefits may include avoided damage, loss of function and displacement. In the case of generator projects, these include:

- Avoided displacement costs: the costs required to move and reside in a temporary location while repairs are performed on the structure
- Avoided loss of public services (for public properties)
- Avoided loss of life or delay in essential services (critical services)
- Avoided loss of service (for utilities)
- Avoided loss of function (for roads and bridges)

> All BCA inputs must be **justified and documented**. When appropriate FEMA standard values are used, it should be clearly stated.

The FEMA BCA Tool provides two modules, Historical Damages and Professional Expected Damages, that can calculate project benefits for proposed generator projects. These two modules both compare user-entered damages/losses and the frequency of occurrence in the before-mitigation scenario versus the after-mitigation scenario to calculate benefits based on avoided damages or loss of function.

This supplement only provides a recommended approach to documenting cost-effectiveness. For detailed guidance on using the FEMA BCA Tool, refer to FEMA BCA Reference Guide and FEMA Supplement to the BCA Reference Guide. For additional questions, contact the BC Helpline at ***dchelpline@dhs.gov*** or at ***1-855-540-6744***. If the FEMA BCA Tool is used, provide a .pdf of the BCA report and an export of the BCS as a .zip file.

The FEMA BCA Tool includes embedded Help Content. Click on the information button within the tool to access the Help Content.

Approach: The calculation of avoided losses for generator projects is based on either documented historical damages (such as physical damages or loss of function) or professional expected damages (estimated damages that have not yet occurred or that occurred but not to the extent probable) from at least one known frequency event. If recurrence intervals (RI) are not known and there are historical damage data from at least three events, the BCA Tool can estimate a RI. Otherwise, additional data collection or analysis will be needed. The calculation compares before- and after-mitigation conditions. Example data is shown is shown in **Table 1** based on historic outage information for a small public works building constructed in 1967. The information was gathered using outage data provided by the electrical utility which included the year of the outage and the duration. Loss of function data was gathered using the annual budget for the public works building and deriving a daily cost for the services provided. Displacement costs are based on records for having to temporarily relocate operations during long-term power outages, and the historical damages are based on records for having the software calculate the event recurrent interval.

Table 1. Before- and after-mitigation estimated damages.

	Historical or Expected Before-Mitigation Damages				Expected After-Mitigation Damages			
Outage Year	RI (years)	Displacement Costs	Loss of Function (days)	Loss of Function ($)	RI (years)	Displacement Costs	Loss of Function (days)	Loss of Function ($)
2014	17	$0	.2	$2,000		$0	0	$0
2016	28	$500	.6	$6,000		$0	0	$0
1989	52	$5,000	7	$70,000	86	$500	1	$6,000

The following describes the essential data required when using historical damages or professionally expected damages in the FEMA BCA Tool. If **Step 1** through **Step 9** of this supplement are followed and all recommended data gathered, there should be minimal additional data collection needed to complete the BCA. To verify the information entered in the BCA software, the following supporting information needs to be provided.

1. Project useful life (PUL) – According to OMB Circular A-76, Performance of Commercial Activities, the PUL for generators or generator sets is 19 years. This value can be used as the default useful life value when performing the BCA. It may be altered based on manufacturer warranty or other documentation that can demonstrate that the generator may be able to provide service for longer than 19 years. Additional resources on standard PULs can be found in the BCA Reference Guide or within the BCA Help Content.
2. Project cost – Refer to **Step 5**.
3. Provide the annual maintenance cost associated with maintaining the effectiveness of the components installed as part of the mitigation project.
4. To calculate the costs of loss of service, provide the following information for the facility type being mitigated:
   - **Fire Stations**
     - Type of service area served by the fire station (e.g., urban, suburban, rural, wilderness)
     - Number of people served by the fire station
     - Distance to the next closest fire station that would provide fire protection to the jurisdiction normally served by this fire station (in miles)
     - Distance in miles to the next closest fire station that would provide emergency medical services for the jurisdiction normally served by this fire station (in miles), if applicable
   - **Hospitals**
     - Number of people served by the hospital
     - Distance to the next closest hospital (alternate hospital) that would treat the population served in the event this hospital was inoperative (in miles)
     - Number of people served by the alternate hospital

- **Police Stations**
  - Type of area served by this police station (e.g., metropolitan, city, rural)
  - Number of people served by this police station
  - Number of police officers working at the police station
  - Number of police officers that would serve the same area if the station were shut down due to a disaster
- **Other Facilities**
  - Service name (type of service)
  - Total annual budget, operating costs or revenue (must be provided with supporting documentation)

5. The RI of the natural hazard event documented in **Step 9** that would cause power failure, demonstrating the need for a backup power source (generator).
   - If the facility lost power because of wind damage to power lines feeding the facility, the analyst can utilize the Advanced Technology Council Wind Speed Tool to determine the frequency of the wind event.
   - If power outages are attributed to flooding, recurrence information for the flooding event should be used in the analysis. The National Weather Service provides the Precipitation Frequency Data Server, which can be utilized to establish a frequency for various precipitation events.
   - U.S. Geological Survey stream gauge data can also be used to extrapolate frequency information for flood events, details of which can be found in the Supplement to the Benefit-Cost Analysis Reference Guide.
   - National Snow and Ice Data Center (National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, National Science Foundation)
6. The number of days or partial days that the service was affected (without power) or is estimated to be affected.
7. If there is not enough documentation of historical events, the RI of the damage causing events can be estimated based on professional expertise or reasonable conservative assumptions. One method is to use the RI equation (**Figure 3**) to estimate RIs based on a reasonable chance of power failure caused by the hazard event during the PUL. Since generators have a 19-year project useful life, the equation can be solved for the RI based on the estimated percent chance of failure for different durations of power loss. Consider, if no mitigation is applied, in the next 19 years, what is the probability that the facility will experience one day of power loss? This is likely to be high, around a 99% chance of a 1-day loss of function, which equates to a five-year RI using this equation. Scenarios where there are a smaller number of days loss of function will have a higher probability of occurring and therefore a lower RI. Scenarios with a greater number of days of loss of function will have a lower probability and therefore a larger RI. The expected days loss of function and percent chance of failure should be evaluated for what would be considered reasonable for the facility type and mitigation project. An example estimation of outage duration and probabilities is shown in **Table 2**. A letter from the power utility provider or related official from the local jurisdiction is necessary to further document your assumptions.

$$\mathbf{RI} = \frac{1}{1-\left(1-(\%\text{ chance failure})\right)^{\frac{1}{\mathbf{PUL}}}}$$

Figure 3. Recurrence Interval Equation.

Table 2. Outage duration and probabilities estimation example.

Expected Loss of Function (days)	% Chance of Failure	Recurrence Interval (years)
1	99%	5
4	33%	48
7	10%	181

8. Additional benefits may be realized based on answers to the following questions:
    - Do the services that the structure provides have to be temporarily relocated? Displacement costs are based on the length of time the building is out of service, a one-time cost for setting up and moving to a temporary facility to continue operations and monthly costs for occupying the temporary facility (rent). The FEMA BCA Tool will use FEMA standard values to automatically calculate the avoided losses to contents and avoided displacement costs. If different values are used, supporting documentation must be provided.
    - Does the project prevent loss of service to a utility?
    - Are there any critical services provided from the building such as police, fire or medical services?
9. Estimate after-mitigation damages. For generators, the level of protection is based on the probability of the generator's failure. Consider, what is the probability that the generator will experience failure during a time when there is also power outage? Although the expectation is that generators will start up following a power loss, some studies have indicated that there is a 20 to 30% chance that a standby generator will not initially startup. Typically, in these situations, the generator can be quickly started, but in some instances the generator could take longer to repair. A more simplified approach may be to assume that there is an overall lower percent chance that the generator may not start following an extended power loss and use that method to calculate the after-mitigation RI.
    - For example, the equation for calculating RIs can be used to estimate the RI of having a 1-day loss of function caused by equipment failure of the new generator. It can be assumed that over the generator's 19-year PUL, there is a 10% chance that, during a power outage the generator might not function (fail) which would result in a 1-day outage duration for the facility. When 10% is used for chance of failure and 19 years for the PUL, a RI of 181 years is calculated as shown in the example in **Figure 4.**

Estimate RI based on chance of generator failure during PUL:

$$(1)\quad \mathbf{RI} = \frac{1}{1-\left(1-(\%\text{ chance failure})\right)^{\frac{1}{\mathbf{PUL}}}}$$

$$(2)\quad \mathbf{RI} = \frac{1}{1-\left(1-(0.10)\right)^{\frac{1}{19}}}$$

$$(3)\quad \mathbf{RI} = 181\text{ years}$$

Figure 4. After-mitigation recurrence interval calculation example.

Potential Sources:

- Supporting documentation for loss of service calculations can include census data, local maps, mapping or GIS programs, facility operations management reports, emergency plans for the facility or documents such as annual reports.
- Insurance claims, receipts from repair of damages due to power loss, FEMA Public Assistance projects, BureauNet data, documentation of lost service from a utility provider, Public Works department
- Local power outage information from power company

STEP 11: Environmental and Historic Preservation Considerations

Description: Environmental and historical preservation compliance will need to be considered as part of the application process for a generator project. The assistance of a licensed professional engineer, architect or contractor may be required to help obtain the necessary information about EHP compliance. Refer to the EHP Supplement Job Aids.

Below is a comprehensive list of resources identified throughout this supplement. Not all these resources are necessary for generator room project but are provided to ease identification of source material.

PROGRAM AUTHORITIES

- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, 42 U.S.C. 4001 et seq.
- 44 Code of Federal Regulations, Part 206, Subpart N
- 2 Code of Federal Regulations, Part 200

PROGRAM GUIDANCE

- FEMA Hazard Mitigation Assistance Guidance (and Hazard Mitigation Assistance Guidance Addendum)
- Benefit-Cost Analysis Reference Guide and Supplement to the Benefit-Cost Analysis Reference Guide

TECHNICAL GUIDANCE AND STANDARDS

- International Building Code (IBC) 2018 (or most recent version)
- International Existing Building Code (IEBC) 2018 (or most recent version)
- International Residential Code (IRC) 2018 (or most recent version)
- National Electrical Code 2020 (or most recent version adopted by Authority Having Jurisdiction [AHJ])
- Standard for Emergency and Standby Power Systems – NFPA 110-2019 (or most recent version adopted by AHJ)
- Applicable Local and State Codes (consult the location building authority or AHJ for resources)

ADDITIONAL TOOLS AND RESOURCES

- Advanced Technology Council Wind Speed Tool
- FEMA's How to Find Your FIRM and Make a FIRMette

- FEMA's Map Service Center
- FEMA's Benefit-Cost Analysis (BCA) Tool
- Cost Estimating Principles for Hazard Mitigation Assistance Applications
- FEMA's National Flood Hazard Layer
- Hazard Mitigation Assistance Application Development Scope of Work Examples
- Hazard Mitigation Assistance Application Development Engineering Case Studies
- EHP Review Supplements
- FEMA Hazard Mitigation Assistance Job Aids
- National Snow and Ice Data Center
- National Weather Service (NWS) Precipitation Frequency Data Server
- National Oceanic and Atmospheric Administration (NOAA) Weather Observation Stations
- U.S. Geological Survey (USGS) Flood Event Viewer
- USGS National Water Information System stream gauge data
- USGS Earthquake Hazard Program