National Manual of Assets and Facilities Management

Volume 5, Chapter 2

Natural Phenomena Hazards Mitigation Procedure

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1.0 PURPOSE

Facilities Management (FM) departments are traditionally responsible for ensuring the efficient and cost-effective operation of an entity facilities and physical plants. This document addresses O&M responsibilities and actions in response to events relating to Natural Phenomena (NP). It offers guidance on how users can plan to mitigate the potential impacts caused by NP related events and ensure that the required protective measures are in place to enable the maintenance and continuity of any vital services.

The O&M Department is the cornerstone of any organization's ability to continue operating through any NP related event and provides the foundation for a timely recovery in case such an event should occur. Understanding the potential impact of an NP related event and planning for such an event is crucial and requires an overall knowledge of the facility and its operations.

Preparation and planning of an NP event allows an organization to mitigate any potential consequences incurred as a result of the event.

The diagram below outlines the steps required to identify, prepare for, assess and mitigate the risks posed by a given hazard, thereby protecting the facility from the consequences of an NP related event.

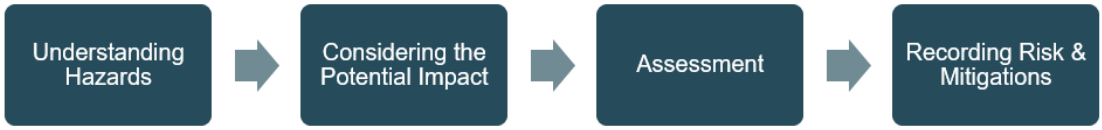

Figure 1: Steps for Natural Phenomena Related Hazard Mitigation

2.0 SCOPE

O&M departments within the Kingdom of Saudi Arabia are most vulnerable to natural phenomena caused by winds, floods, earthquakes, and fires. Advancements in technology and communications can provide O&M related entities with advanced warning. Many, though not all, significant weather events are communicated by specialized governmental entities as a part of their emergency communication management.

NP events, such as catastrophic power outages caused by earthquakes or major industrial accidents, can often occur without warning. The best way to mitigate against the impact of these types of events is to have in place comprehensive, well-documented, and tested plans. Such plans should incorporate potential engineering-related issues, as well as operational measures.

National and local codes and standards address the minimum basic requirements for emergency-power, water, Heating, Ventilation, and Air Conditioning (HVAC), fire-protection, lighting, fuel-storage, and communication systems. These requirements provide for the life safety and immediate needs of the facility's users and guests and are addressed throughout Volumes 5 and 6 of the National Manual of Assets & Facilities Management (NMA&FM).

The O&M Department should also address a facility's ability to provide an increased demand for services following an emergency and protect the physical plant, facility or extended operations without the support of MOI.

The first step to preparing for a potential hazard is understanding the range of impact that a natural phenomenon can have on a given facility. Using this information, the potential vulnerability of utility and operational systems (impact) can be assessed and protective measures to ensure the continuity of these systems can be determined.

Analysis includes evaluating each component of the building's operation, supplies, physical plant, communications, and utilities to determine the potential failure modes for each system. Managers can then categorize the impact of potential system failures into three basic areas which affect operations, the facility

and the recovery process. They can then determine recommendations for upgrades to their system to minimize failures, and forward these recommendations in accordance with their entities' Emergency Management Procedures.

3.0 DEFINITIONS

Term	Definition
	Research
	Completed Task
AFFF	Aqueous Film Forming Foam
CPG	Comprehensive Preparedness Guide
EMC	Emergency Management Committee
Entities	A Saudi Government organization which is responsible for the delivery of government funded infrastructure.
Facilities	Building and/or enclosed or unenclosed industrial processes as well as all its site features.
FEMA	Federal Emergency Management Agency
GFDRR	Global Facility for Disaster Reduction and Recovery
HAZID	Hazard Identification
HVAC	Heating, Ventilation, and Air Conditioning
KSA	Kingdom of Saudi Arabia
NMA&FM	National Manual of Assets & Facilities Management
NP	Natural Phenomena
MERS	Middle East Respiratory Syndrome
MOI	Ministry of Interior
O&M	Operations and Maintenance
Risk Assessment	Formal approved assessment and record of hazard and associated risks stating suitable and sufficient control
SPR	Stakeholder Preparedness Review
THIRA	Threat and Hazard Identification and Risk Assessment

4.0 REFERENCES

- Federal Emergency Management Agency (FEMA) Comprehensive Preparedness Guide (CPG) 201: Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR)
- FEMA Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining Emergency Operations Plans
- FEMA Local Mitigation Planning Handbook 2013
- ISO 22326 Emergency management Guidelines for Monitoring Facilities with Identified Hazards
- ISO22320 Emergency Preparedness
- EOM-EM0-TP-000002 Expro Risk Register Template
- National Manual of Assets & Facilities Management Volume 14 – Emergency Management
- National Manual of Assets & Facilities Management Volume 12 – Risk Management

5.0 RESPONSIBILITIES

Careful planning in advance of an emergency gives an organization a far better chance to successfully navigate an NP event. It also provides the facility the opportunity to maintain vital services meeting the needs of the users. Defining the roles and abilities of the Maintenance and Engineering Department in emergency preparedness must commence in the planning process.

It is the responsibility of the Emergency Planning group to identify the requirements and roles needed to meet the demands of the emergency plans.

It is the responsibility of the Operations/Facility Manager to provide the hazard mitigation risk register to the Emergency Planning group for consideration and inclusion within the Emergency Plans.

6.0 PROCESS

The following diagram depicts the process for recording new hazard mitigations or reviewing existing mitigations.

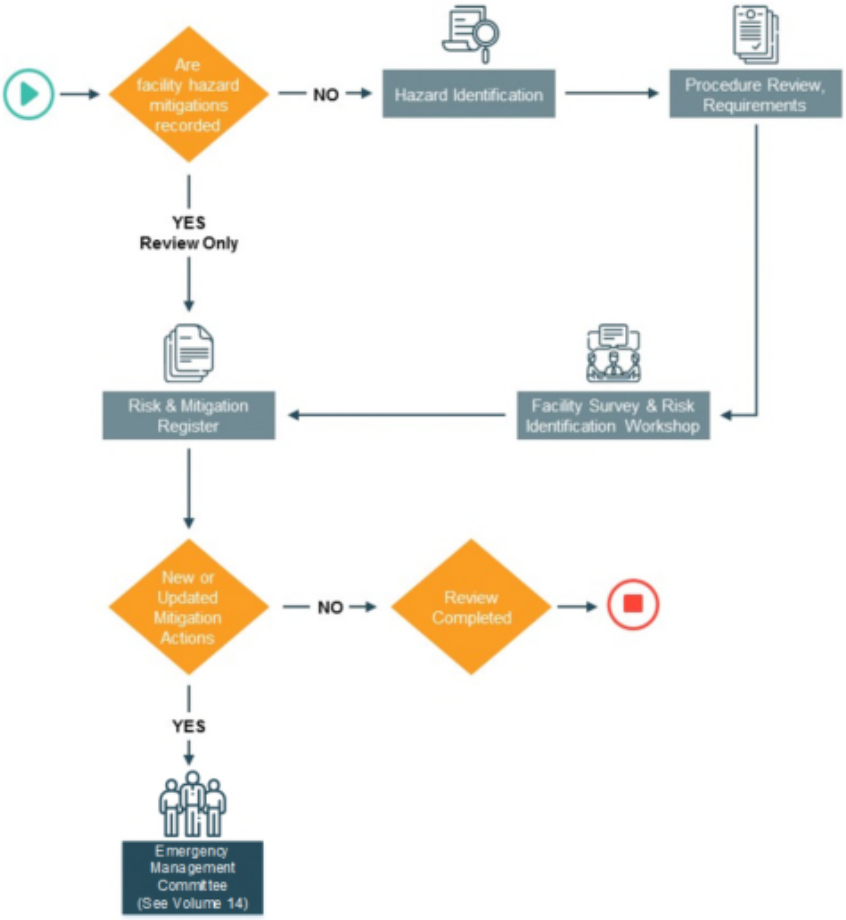

Figure 2: Natural Phenomena Hazards Mitigation Process

6.1 Review Current Situation

The first step the reviewer should consider is to research the organization's Emergency Management Procedures, emergency plans and business continuity plans. Natural hazards may already be defined along with their potential impacts. It should be considered at this stage whether or not a review of existing mitigations is all that is required or if there is a need to record new mitigations.

The reviewer should review and evaluate the emergency planning services and guidance provided by the MOI and that the information supplied by FEMA for emergency planning be reviewed. This procedure utilizes some of the planning tools provided by FEMA.

6.2 Hazard Identification

Figure 3: HAZID

A list of possible hazards impacting the organization shall be developed. A sample list of naturally occurring phenomena has been provided in below as an example:

- Avalanche
- Drought
- Earthquake
- Epidemic/Pandemic
- Flood
- Hurricane/Typhoon
- Space weather
- Tornado
- Tsunami
- Volcanic eruption
- Sandstorms

The following two criteria should be considered when identifying hazards:

- The likelihood of the hazard affecting the facility or organization; and
- The impact the hazard may have on a facility

The number of hazards to include in the hazard identification process depends on the specific risk profile of the facility.

Thorough research and a consultation of multiple sources should be conducted during the hazard identification process, as this helps to establish a comprehensive list of the threats associated with the hazards that the facility may face.

These sources may include, but are not limited to:

- The relevant organizational operating procedures
- Existing threat or hazard assessments (e.g., hazard identification and risk assessment)
- Forecasts or models of future risks due to changing weather, demographic patterns or any other emerging threats

- Entity hazard mitigation plans
- Records from previous incidents including historical data
- Health related information and advice issued by the region's Ministry of Health (e.g., Middle East Respiratory Syndrome (MERS))
- Ministry of Interior's website, Emergency Management advice, policies, and procedures
- Private-sector plans and risk assessments including those for lifeline functions (communications, energy, transportation, and water)
- Global Facility for Disaster Reduction and Recovery (GFDRR)

6.3 Hazard Impact

Figure 4: Hazard Impact

The possible impact of any identified hazards is determined by the level of capability that a given facility will need to address. To begin to understand the risks associated with these hazards effectively, O&M Department should first identify the hazards that pose the greatest potential impact to their facility and their capabilities.

Hazard descriptions must include crucial details that identify the impact the hazard or incident can have on the facility and the capabilities required to manage it.

The examples provided in Table 2 below demonstrate examples of critical elements and details that should be considered when developing context descriptions which identify the event or hazard and its potential impact on a facility.

Best practices for developing context descriptions	
Questions to consider	**Examples in practice**
How would the **timing** of an event affect the facility's ability to manage it? What time of day and during what season is the event most likely to occur or have the greatest impact?	Facility A is very popular during examination season. A tornado occurring at 7:00 p.m. in May might have a great impact, as large numbers of students will be frequenting the facility.
How would the **location** of an incident affect the facility's ability to manage it? Which locations are the most likely to be affected by an incident or experience the greatest impact (e.g., populated areas, coastal zones, industrial or residential areas)?	Our healthcare facilities have a high population density in the south and very low population density in the north. An earthquake might result in the greatest impacts in the south, where our facilities are most needed.
What other **conditions or circumstances** would make the hazard a concern (e.g., atmospheric conditions like wind speed/direction and relative humidity, or multiple incidents occurring at the same time)?	Facility B experiences high winds and intense sandstorms. The worst impacts might occur on a day with increased wind from the south which is directed towards the air intakes for the facility HVAC.
What social or physical vulnerabilities make the hazard a specific concern? (e.g., flood-prone areas, populations with limited or no ability to evacuate)?	Facility C is in a known flood zone; access roads are often closed. Our facility provides essential lifesaving services which are reliant on standby diesel power generators.

Table 2: Questions to Consider when Developing Context Descriptions

The example below illustrates the difference between context descriptions with sufficient levels of detail and those with an insufficient level of detail. The example of a context description with adequate detail provides suggested types of information that a community might want to consider, including in their context descriptions.

Example context description: Insufficient level of detail
High levels of rain will flood the facility

Example context description: Sufficient level of detail
Our facility is located adjacent to a flood plain. Historical records dating back several years suggest that the land we use for parking has flooded previously. There is no drainage within our car parks to divert floodwaters. It is possible for floodwater to run into our facility and settle in the car parks and the lower levels of the buildings. During the daytime, our parking areas are full. We have no public transport services near our facility.

Table 3: Examples of Context Descriptions with Sufficient and Insufficient Levels of Detail

6.4 Emergency Management Plans and Procedures

Figure 5: Linking Procedures

6.4.1 Linking Procedures

Procedure Review

Before proceeding to the assessment phase, review current operating procedures which apply to the facility. This review shall be led by the Emergency Management Committee (EMC) through the process set out within Volume 14 of the NMA&FM.

Refer to any emergency management procedures, business continuity plans and procedures, and communication management plans. Consult with the Health, Safety, and Standards Department (or similar) for more advice.

During this research phase, identify any actions which should be included within the O&M Hazard Mitigation Plan. An example of a scenario for which an O&M Hazard Mitigation Plan should be developed is provided below:

- As the O&M provider of a healthcare facility, you are required to provide and maintain safe evacuation routes and ensure a continuous 96-hour power supply for emergency elevators to support the healthcare emergency evacuation plans.

Mitigation plans to ensure a continuous power supply for elevators and provide safe evacuation routes in the above scenario may include:

- The installation of specific protective measures for initial and secondary power supply maintenance during an event
- Regular safety tours of emergency evacuation routes and testing of evacuation plans

Competencies and Training

Specific competencies or training may be required to meet the customer's emergency management needs. O&M, for example, will provide a fire evacuation warden service in the event of an emergency evacuation. In order to meet the needs of the customer, each Fire Warden should be fully trained on the use of two types of fire extinguishers including Aqueous Film Forming Foam (AFFF) and Pressurized Water. This training should be maintained by the appointed Fire Warden annually.

Further details of relevant competencies are identified in Volume 14 of the NMA&FM. To meet customer demands, both the training requirement and competence assessments will need to be actioned as required mitigations.

6.5 Facility Assessment

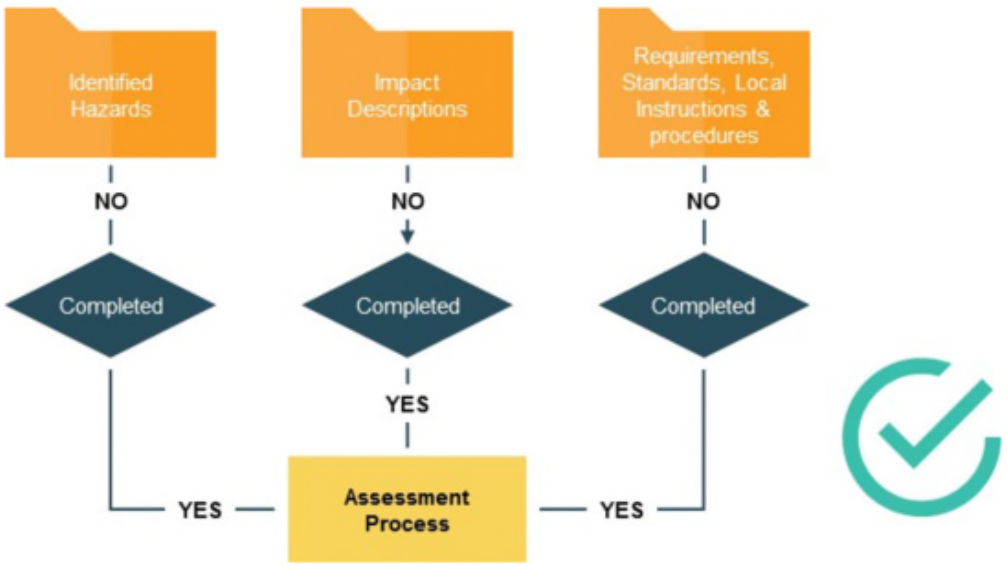

Figure 6: Link between Research Phase and Assessment Phase

Using the information collected during the research phase, the assessment phase can be initiated. The aim of the assessment process is to list specific risks and provide the identified mitigation measures to be implemented to protect the facility and ensure continuous service.

Figure 7: Risk Assessment Process

The information gathered from the research phase is used as input for facility surveys, risk workshops, and a risk register. The details gathered from this step will in turn be used within the planning stage.

6.5.1 Facility Surveys

Understand your facility and the equipment you are required to protect.

Figure 8: Facility Survey and Risk Identification Process

Each facility is advised to compile a list of the assets they are required to protect. This is especially important when the requirement is to maintain the use of the asset during and immediately after an emergency event. Example being standby power supply, lifesaving systems and water systems.

Your surveys should consider the identified hazards and impacts and answer that they have been included within the survey reports.

Hazard	Impact/Context	Survey
Flood	Our facility is located adjacent to a flood plain, there is historic records dating back several years which show that the land we use for parking has flooded previously. There is no drainage within our car parks. It is possible that the floodwater will run towards our facility and settle within the lower levels	No essential equipment is located within the basement rooms
Earthquake	Our facility is solely reliant on the national power grid for all its electrical needs to operate the life safety systems. An earthquake hazard which disrupts the power grid will shut our systems down	Backup generators are in place. Fuel reserve sufficient for 14 hours

Table 4: Examples of Identified Hazards and their Impacts on a Facility based on Survey Reports

6.6 Operational Systems Risk & Mitigation Workshop

Figure 9: Risk Identification & Mitigation Workshop Process

Every facility has several operational systems which will require protection against the impacts of an event and to ensure they continue to operate during and after an event.

Each of the components of the building's operations, supplies, physical plants, communications and utilities are evaluated during the risk identification workshop to determine the potential failure modes for each system.

The working group can categorize the impact of potential system failures into three basic areas of benefits operations, facility, and recovery. They can subsequently determine the most cost-effective upgrades (if required) to that system to minimize failures.

It is advisable to arrange a risk and mitigation workshop at this stage of the process. To develop the most comprehensive list of risks and mitigations, the following parties and resources should be utilized in the risk identification workshop:

- Users of the facility
- Contractors
- Maintainers
- Operations & Facility Managers
- Resources relating to local emergency services
- Entity health, safety and standards

Provide the group with the hazards list, impact context descriptions, and survey lists identified during the research phase. Include any historic risks previously highlighted by others during previous risk workshops.

The purpose of this workshop is to document the specific risks which will affect the facility and provide the mitigations which will protect its services.

6.6.1 Identify and List Risks

Risk is defined as an uncertain event or a condition that, if realized, has an effect on at least one objective, it also refers to the probability or threat of quantifiable damage, injury, liability, loss, or any other negative occurrence that can be incurred as a result of external or internal vulnerabilities, and that may be avoided through preemptive action.

There are various tools which can help assist groups in identifying and recording risks. Volume 12 Risk Management of the NMA&FM provides more detail.

6.6.2 Mitigation: Goals, Actions, Action Plan

Mitigation is the effort to reduce loss of life and property by lessening the impact of disaster events. Mitigation refers to taking immediate action – through risk analysis and reduction, or insuring against risk to reduce the consequences of disasters.

Effective mitigation requires an understanding of local risks and current capabilities and a commitment to investing in long-term facility wellbeing.

The mitigation strategy is made up of three main components: mitigation goals, mitigation actions, and an action plan for implementation. These provide the framework to identify, prioritize, and implement actions to reduce risk and hazards.

Mitigation goals are general guidelines that explain what the group wants to achieve with the plan. They are usually broad policy-type statements that are long-term, and represent visions for reducing or avoiding losses from the identified hazards.

> Example goal: Protect basement plant room from potential flooding

Mitigation actions are specific activities that help achieve goals.

> Example action: Provide water ingress protection and drainage. This should include a pumping system with independent power supply

The action plan describes how the mitigation actions will be implemented including how those actions will be prioritized and administered.

For example:

- Retrofit water collection and draining channels to divert water away from plant room
- Create a sump and pumping system to remove water from basement
- Develop draining system to prevent water from entering the basement area

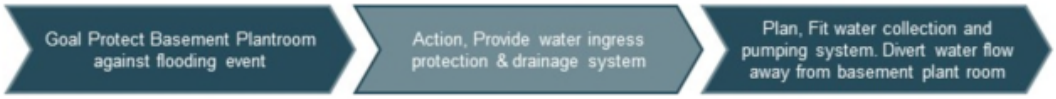

Figure 10: Mitigation Action to Protect against Basement Plant Room Flooding Event

6.6.3 Recording Risks and Mitigations

Figure 11: Recording Risks and Mitigations Process

Record identified risks and their associated mitigations.

A risk register should be used to record risks identified during the risk workshops, and their associated mitigations. Expro provides a Risk Register Template (EOM-EM0-TP-000002), available within the Risk Management Procedure (EOM-EM0-PR-000001). This register is to capture risks and mitigations.

Use the Risk Assessment to Inform Plans and Policies

The risk assessment provides data, analysis, and information that can be integrated into other plans to guide policies and decision-making. For instance, the risk assessment can form the basis for other Emergency Management program activities, including emergency operations and evacuation planning. Incorporation of hazard information and the development review process can guide growth and redevelopment away from high-risk locations. This information can also be used to design future public facilities to minimize exposure to hazards.

A sample risk register is provided in Attachment 1 below.

6.7 Emergency Planning

Emergency Planning is covered in detail within Volume 14 of the NMA&FM.

Using the completed Risk Register, the entity's emergency planning group must review the risks and consider any mitigations provided by the review group.

New plans should be created, or existing plans updated.

6.7.1 Emergency Plans

The Emergency Operations Plan should address the management of available resources and on-site supplies and assets to ensure operational capability. These measures may include consolidating operations into small areas of the building to conserve power and air conditioning, using gray water or well water for sanitation to conserve drinking water, and implementing building-wide, rolling blackouts of air conditioning to minimize indoor humidity.

Plans will define the communication structure during emergency situations (e.g., gold and silver emergency command and control levels of reporting during an emergency event) and the actions required by the employees to meet the demands of the plan. Evacuation checks, firefighting, essential equipment isolations may be included. The Emergency Operations Plan should also specify those individuals or parties responsible for restoring a facility's operations to normal, with minimal delay and impact to its infrastructure.

A comprehensive and well-documented Emergency Operation Plan will serve as a valuable resource for managers forced to make difficult decisions under pressure. Every plan must be tested. This may require frequent management meetings to discuss and organize emergency exercises to ensure operational capability.

Volume 14 of the NMA&FM will provide guidance on plan testing and training.

7.0 ATTACHMENTS

1. Sample Facility Hazard Impact Survey Record Sheet

Attachment 1 – Sample Facility Hazard Impact Survey Record Sheet

On Site Hazard Impact Survey Record Sheet					
Item Number	**Hazards** (e.g., Flood, Severe Sandstorm, Earthquake, High winds	**Equipment/Asset Description**	**Impact Context**	**Survey notes 1**	**Survey note 2**
1	Flood	Plant room within basement car park Fire control panel room Staff car parking Toilet facilities Customer warehouse room	Our facility is located adjacent to a flood plain, there is historic records dating back several years which show that the land we use for parking has flooded previously. There is no drainage within our car parks. It is possible that the floodwater will run towards our facility and settle within the lower levels.	Shallow drainage channels are cut across access roads. Noted they were full of sand	No drainage provided in the basement area
2	Flood	Ground floor car park	Our facility is located adjacent to a flood plain, there are historic records dating back several years which indicate that the land we use for parking has flooded previously. There is no drainage within our car parks. It is possible that floodwater settle within the car park	No raised foot paths or drainage within car park	Car park heavily used during the daytime. Limited use after office working hours. Overhead lighting is provided and operated on a timer system
3	Severe Sandstorm	Access roads and pathways	Access to our facility is directly from the main highway. This is by a tarmac double track road. Approx. length is 500 meters. This road leads to the facility building and associated car park. The car park can hold 243 cars. Our site is isolated and subjected to cross wind North/South. No sand defenses are in place which allows the buildup of sand occasionally. After a weekend last winter, the access road was blocked by sand	No sand defenses are present along the access road. No drainage present. No overhead lighting	White lining is within the center of the road. Yellow edge lining denotes the outer limits of the road
4	Earthquake	External fuel storage tank for emergency power generators	External fuel storage tanks are located at the outer edge of the facility. Access is by a single track of hard compacted stone edged with soft sand. System is fitted with vibration protection system, fire suppression, and auto shut down	Access road is poor quality and maybe impacted during an earthquake event. Soft sand surrounding tanks may present risks	