



**ABU DHABI WATER AND ELECTRICITY
AUTHORITY (ADWEA)**

Effective Date : 18.06.2009

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ADWEA HAZARD EVALUATION & FINDINGS REPORT

Approved by:

Planning & Development Director:



HAZARD ASSESSMENT EVALUATION & FINDINGS REPORT

Prepared by: _____ **Date:**
HSE SPECIALIST

Reviewed by: _____ **Date:**
TECHNICAL ADVISOR

Approved by: _____ **Date:**
PLANNING & DEVELOPMENT
DIRECTOR



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A. PART 1: PROJECT PURPOSE AND SCOPE

A.1. INTRODUCTION

Awareness and Preparedness for Emergencies is a tool developed to minimize the occurrence and harmful effects of technological accidents and emergencies. It provides a well structured, detailed description of how to develop a coordinated, integrated, and well functioning emergency response plan. The strategy and approach is to identify and create awareness of risks, to initiate measures for risk reduction and mitigation, and to develop preparedness for emergencies.

Emergency preparedness can be useful in any situation that requires joint planning for disasters by several parties, e.g. government, industry, and local communities. Being aware and prepared means having workable, realistic plans if an accident occurs. It also means creating a better understanding of local hazards, which in turn should lead to action designed to prevent accidents from happening at all.

While some major industrial accidents can be contained within the boundaries of the plant, in other cases, there are impacts on the surrounding neighborhoods, with adverse short- or long-term consequences affecting life, life-support systems, society, or property. This is even more so for accidents arising from transport of dangerous goods, e.g. by road, rail, or pipeline, through or close to populated areas, since by definition there is no boundary fence in these cases. The extent of the losses from these accidents depends largely on the actions of the first responders to an emergency, both at the scene of the accident and within the surrounding community.

Clearly, adequate response to such situations calls for co-operation between various institutions and individuals. This can be achieved only if there is awareness within the community of possible risks and of the need for joint preparedness to cope with the consequences of these risks.

The Emergency Preparedness concept for disaster management aims at

- Strengthening the emergency response capabilities.
- Setting a frame for establishing and practicing in advance the required skills and capabilities for handling any emergency situation



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- Getting together and coordinating all local agencies and the available expertise that is needed for accident/disaster prevention, preparedness, emergency response and mitigation.
- Identifying in advance all hazards and risks relevant for a community, measures for reducing the risks, and the consequences of any emergency situation that may arise.
- Training is to be provided concerning the specific emergency situations that may affect that particular community (disaster managers, first responders, search and rescue teams, medical services, media, internal and external communication and communication lines, etc., and the community).

Emergency preparedness must include capacity building, resource and needs analyses, and the development of robust response capabilities to address those risks that can not be effectively mitigated. Moreover, relationships must be developed and maintained with persons, contractors, and organizations that will assist in times of emergency.

Utility infrastructures are designed to withstand many natural forces, but may be unable to withstand some, particularly the rarer and higher impact events. Utility infrastructures also present appealing targets to malevolent actors and terrorists.

A.2. PURPOSE

The geographic size and complexity of the ADWEA systems makes them vulnerable to a number of different hazards. Many events, which would not ordinarily be of concern, can have exponential impacts on either the system or on customers. Thus, it is imperative for ADWEA to develop a plan for dealing with such impacts expeditiously and affectively to minimize the overall impact, restore or maintain quality service to the customers, and minimize damages to ADWEA's reputation.

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The Emergency Plan will be developed to describe the organization and responsibilities of ADWEA and to define the coordinated actions required to alleviate the effects of a major emergency. It will establish the framework to share emergency information between ADWEA & the Group Companies and between ADWEA & Governmental Authorities.

Emergency plans ensure that a company is prepared to respond to a spectrum of threats ranging from simple trespassing, to vandalism, to civil disruptions, to dedicated acts of terror and sabotage by perpetrators inside and outside the company whose actions may be cyber or physical in nature.


The plans will be implemented for major emergencies affecting a large segment of the power and water systems with the potential for significant adverse impact on public health and safety, or economic disruption; i.e., an event that involves multiple jurisdictions and/or multiple Market Participants, and requires high-level management participation by government and industry to effectively and swiftly accomplish the return to normal condition.

A.3. EMERGENCY MANAGEMENT

Emergency management is ongoing risk-based activities taken by a jurisdiction or entity to prevent, mitigate, prepare for, respond to and recover from emergencies of all types. The purpose of an emergency management program is to protect people, property, the environment and the economy. Of paramount importance is the protection of life. In the broadest sense, emergency management includes both public safety and public security.

Emergencies result when a hazard or threat interacts with a vulnerability to produce adverse consequences in a jurisdiction or entity. Hazards and threats are natural or human-caused conditions or processes that have the potential to cause harm or loss to people, property, the environment or the economy.

Poor or improper management of risks can produce excessive adverse consequences and endanger the sustainability of a jurisdiction or entity. A risk-based all hazards emergency

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management program thus contributes to disaster resilience and enhances the stability of a jurisdiction or entity.


The identification and understanding of hazards, threats, risks and vulnerabilities is therefore an important first step in designing emergency management activities and programs to protect public safety, security, the environment and the economy. A jurisdiction or entity should complete a thorough and systematic review of hazards, threats and risks and their potential impact on its geographic area or business before appropriate emergency management activities can be developed to deal with the possibility of an emergency.

Prevention refers to activities taken to avoid an incident or to stop an emergency from happening. Mitigation refers to activities taken to reduce the severity or consequences of an emergency. Prevention and mitigation measures can greatly diminish the preparedness, response and recovery activities required for certain emergencies, sometimes in a very cost-effective way, and should result in long-term risk reduction.

Preparedness refers to activities taken prior to an emergency or disaster to ensure an effective response. Preparedness measures include continuity plans, emergency response plans, training, exercises, public education, alerting and notification systems, receipt of information or intelligence, procedures, resources, infrastructure, etc.

Response refers to activities taken when actually responding to an emergency. The aim of these measures is to assist individuals, businesses and communities to cope with the immediate impact of an emergency. Timely response, mutual aid and assistance, deployment of liaison staff, specific action plans, the use of standard and familiar incident management systems, public direction, the dissemination of emergency information, logistic support and emergency financial assistance are some of the activities which occur during an emergency response.

Recovery refers to activities designed to return conditions to a level that is acceptable to the jurisdiction or entity. These usually occur over a longer period of time, after the immediate

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impact of the emergency and are planned to assist individuals, businesses and communities to return to normal conditions.

A.4. STRATEGY

There will be a maximum of 3 levels of oversight involved in managing an emergency response within the ADWEA Group:

1. On site (Facility) Incident Management Team (this includes management of Tactical Response Teams).
2. Group Company Emergency Management Team.
3. ADWEA Corporate Crisis Team.

For each level of oversight a plan must be developed and implemented outlining how each team functions and the inter-relationship between the levels of management.

B. PART 2: HAZARD ANALYSIS

Each of the hazards identified is applicable to at least one of the group companies: not all hazards apply to all companies. However, the hazards identified in this report are those that could escalate to a crisis management situation for ADWEA. Hazards that could be handled at the individual facility level are not included.

B.1. GUIDING PRINCIPLES

ADWEA's guiding principles and expectations as they relate to crisis and emergency response are as follows:

- A common emergency management system will be used within the ADWEA Group of Companies for responding to crisis and emergency situations.



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- ADWEA Group Companies must initially overreact to emergency situations. Once a detailed assessment has been completed and the incident potential identified, the response will be sized accordingly.
- In dealing with an emergency, all parts of the response should be addressed concurrently, but the following priorities apply:
 1. Human life.
 2. Environment.
 3. Protection of Facilities.
 4. Business Continuity.

B.2. RISK ANALYSIS

The types of risks evaluated included those that may have a substantial effect on the operations of the ADWEA companies. The risks evaluated include natural, contagion, technological and human-caused events.

- Natural events that may occur and have a severe effect on the water / electricity generation, transmission and distribution system in Abu Dhabi. include storms, earthquakes, solar magnetic disturbances and floods.
- Contagion events that may occur can have a severe impact on the staffing of market participant facilities threatening their ability to sustain operations. This includes risks to health such as disease and contaminants.
- Technological events include equipment failure and the unanticipated loss of inter-dependent services such as telecommunications, fuel shortages, transportation and water supply.
- Human-caused events include human error, criminal acts, terrorism and vandalism.

The hazards listed can all be cited as possibilities of emergency situations; but in each case the likelihood of occurrence varies greatly.



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Accordingly, emergency management programs for certain assigned hazards (threats) and risks must be developed. This is required because the selected hazards and risks are potentially catastrophic. These program responsibilities are as follows:

- radiation and nuclear;
- earthquake and tsunami;
- severe weather including extreme hot weather, drought, lightning / thunderstorms, windstorms, tornadoes and any others not identified;
- Fires / explosions
- Water contamination
- Oil spills / sea water pollution
- Terrorism / Acts of war
- Critical infrastructure failures
- Local, national and international emergency assistance arrangements for all hazards and risks;

Emergency management programs must be developed for all these identified hazards.

B.3. HAZARD AND RISK EVALUATION

B.3.1 Hazards

A hazard is defined as a "source, situation, or act with a potential for harm. in term of human injury or ill health or combination of these" Hazards normally fall into two broad categories:

- (1) Natural hazards; and,
- (2) Human caused.

Based on KERAMIDA's understanding of ADWEA's risk management needs, Abu Dhabi's concerns for emergency situations that could potentially occur, and commonly accepted principles in risk management, the following list of hazards was developed for further evaluation:



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1. Fire
2. Explosion (All kinds and causes)
3. Hazardous Materials Release
4. Sea Water Intake Damage / Contamination
5. Tsunami / Hurricane
6. Flood
7. Earthquake / Seismic
8. Threat (Bomb, Radiological, Biological, Chemical, Contamination of water supply)
9. Terrorist Attack
10. SCADA failure
11. Communications failure
12. Epidemic

Each of the ADWEA companies has emergency response plans (ERP) to address some of those of the above identified risks that they have or may face. The dilemma faced by infrastructure managers is that they must try to manage these risks at large production plants and across huge geographic distances where their facilities face many vulnerabilities. These plans have been developed to address crises that have already occurred, are likely to occur, or if they do occur would have significant consequences.

Several of the above identified risks are not, however, addressed by the ERPs of the ADWEA affiliates, either because such hazards, were not considered applicable at the time the ERPs were developed (ex. terrorism) or because the hazard's probability may not have risen to the level of inclusion in an affiliate's ERP but it is important for ADWEA's corporate risk plan to address it (ex. epidemic).



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B.3.2 Risks

Risk is defined as the “Combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s)..”

Risk assessment defined as Process of evaluation the risk(s) arising from a hazard(s), taking into account the adequacy of any existing controls, and deciding whether or not the risk(s) is acceptable

The calculus of preparedness and probability defies easy solutions, in part because some hazards can not be statistically patterned (terrorist attacks) and because some high-consequence hazards occur very infrequently.

B.3.3 Probability

Probability is the mathematic study of outcomes based on an experience set, usually derived by experiment, observation, or history. Some events can be predicted with reasonable reliability or through modern tools (weather radar and satellites help track movement of storms) similarly some events (earthquakes) are known to repeat on certain cycles (and can also be monitored using contemporary instruments). Some events are not capable of statistical modeling because they involve conscious thinking actors. For these hazards (terrorist attacks) more anecdotal means must be employed.



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Table 1 – Estimate of Likelihood of Occurrence

Probability	Frequency	Discussion
Rare	Highly Unlikely.	This category would apply to incidents that, from past experience or intuitive consideration are possible, but would not probably occur in a lifetime. There is no history of incidents in at least the last 15 years in the facility, the country, the region, or the world. A “one in a million” chance would describe the subjective estimate.
Low	Unlikely	This category would apply to incidents that can or have occurred, but not often. There has been no documented occurrence for five to fifteen years in the facility, the country, the region, or the world.
Moderate	Possible, more likely than not	This category would apply to incidents that may have occurred more often. There is a history of a single incident in the last five years at least in the facility, the country, the region, or the world.
High	Likely	This category would apply to those incidents that are quite likely to occur and in fact are expected to happen from time to time. There have been multiple or recurring incidents in the last five years in the facility, the country, the region, or the world.

B.3.4 Consequences

Some hazards, however unlikely they may be, carry substantial consequences. The analysis of risk accounts for both high-probability/lower consequence events, and low probability/high-consequence events.

Table 2 – Categories of Impact

Impact Category	Consequence
Negligible	<input type="checkbox"/> No casualties <input type="checkbox"/> No property damage <input type="checkbox"/> No environmental impact <input type="checkbox"/> No business continuity impact <input type="checkbox"/> Some inconvenience
Minor	<input type="checkbox"/> Minor injury, no long term disability <input type="checkbox"/> Minor damage requiring minor repairs <input type="checkbox"/> No environmental impact <input type="checkbox"/> No outside assistance required
Severe	<input type="checkbox"/> Severe casualties or death, long term disability <input type="checkbox"/> Structural damage <input type="checkbox"/> Significant environmental impact <input type="checkbox"/> Outside assistance needed
Catastrophic	<input type="checkbox"/> Significant casualties and deaths <input type="checkbox"/> Major structural damage, construction required <input type="checkbox"/> Significant environmental impact <input type="checkbox"/> Business continuity threatened

B.3.5 Risk and Consequence Analysis

Abu Dhabi governmental and emergency management officials have adopted a mathematic matrix for hazard and risk analysis. The matrix scores various hazards using probability multiplied by consequence. The consequence scoring table (below) is representative of the methodology. Policy makers should be cautioned that mathematic analyses can be misleading and can under represent some risks that are controlled by human factors, some geologic and weather events that may not easily be patterned or subject to actuarial analysis.

Table 3 – Risk Classification Matrix

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16</i>				

C. PART 3: IDENTIFIED POTENTIAL HAZARDS AND RISKS RANKING

C.1. Process

The potential hazards and risks listed in Section B.3.1 and evaluated in this chapter were identified through the following processes:

- Site Visits to ADWEA’s affiliated companies.
- Review of the Emergency Response Plans of ADWEA’s affiliated companies.
- Meetings with Representatives from ADWEA and its affiliates.
- Historical Information Review.
- Abu Dhabi and International Guidelines Review.
- Development of Hazard Identification and Risk Assessment Tool (described in Part 2).

C.2. Development of Rankings

The evaluation of the twelve identified potential hazards is presented in the following pages of this section. Hazards have been ranked and highlighted based on significant to high risks. Each analysis summarizes the hazard, probability, consequence and final consequence score.



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SCENARIO 1

FIRE

Background

Fire is a risk in any industrial facility. The production facilities manufacture electricity which itself can cause fires, they store and use large amounts of flammable chemicals (fuels) that if ignited would produce large fires.

Type of Hazard / Risk: Human-caused: Non-Intentional and Intentional

Probability



Fire probability is a function of maintenance, training, procedural adherence and safety.

	Probability	Frequency
	Rare	Highly Unlikely.
	Low	Unlikely
	Moderate	Possible, more likely than not
	High	Likely

Consequence

Fire is an inherently destructive force, destroying everything in its path until available fuel is consumed, oxygen is removed, or the fire is suppressed via fire suppression (automatic or via fire fighters)

Most facilities have fire detection systems, fire suppression systems, and active fire brigades on the property. These measures mitigate the potential spread of fire.

Fire in a fuel storage depot could interfere with operations.

Key Consequences

(Depending on size of fire, and what burned)

Consequence Score
6 – 16 HIGH

Casualties and deaths	Minor to Catastrophic
Property damage	Minor to Catastrophic
Environmental impact	Minor to Catastrophic
Business continuity	Minor to Catastrophic

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-2; Moderate – 3-6; Significant – 7-10; High – 11-16</i>				



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SCENARIO 2

EXPLOSION

Background

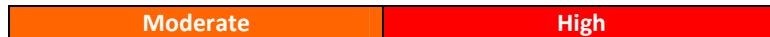
Explosions can be caused by accidental releases of flammable chemicals, by over pressurized pipes or conveyances, by catastrophic failures, or by various malevolent acts.

The cause of a particular explosion is not likely to be known for some time, generally after the incident is stabilized enough to allow an investigation.

Explosions themselves carry significant risks of injury, death and property damage. Fires and structural damage often accompany explosions. Deliberate explosions may include a variety of hazardous substances including chemicals, shrapnel, chemical, biological, or radiological materials designed to magnify the impact of the explosion.

Type of Hazard / Risk: Human-caused: Non-Intentional and Intentional

Probability



Explosive probability is a function of maintenance, training, procedural adherence and safety.

	Probability	Frequency
	Rare	Highly Unlikely.
	Low	Unlikely
	Moderate	Possible, more likely than not
	High	Likely

Consequence

Explosions produce a fragmentation effect, a blast effect, and an incendiary thermal effect. An explosion can cause serious injuries, death, and significant property damage including structural compromise and even collapse. Fires can be ignited by the explosion, which is an inherently destructive force, destroying everything in its path until available fuel is consumed, oxygen is removed, or the fire is suppressed via fire suppression (automatic or via fire fighters)

Most facilities have fire detection systems, fire suppression systems, and active fire brigades on the property. These measures mitigate the potential secondary impact from fire but may be victims of some explosive events. Terrorists and criminals are known to set secondary explosive devices designed to injure responding fire and police officials.

Fire in a fuel storage depot could interfere with operations.

Key Consequences

Casualties and deaths	Severe to Catastrophic
Property damage	Severe to Catastrophic
Environmental impact	Severe to Catastrophic
Business continuity	Severe to Catastrophic

Consequence Score

9 – 16 HIGH

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16</i>				



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SCENARIO 3

HAZARDOUS MATERIALS RELEASE

Background

Most of the ADWEA facilities handle large quantities of hazardous chemicals. Fuels, disinfection chemicals, treatment chemicals, lubricants and additives are toxic and, many are flammable, some are explosive at ambient air temperatures. Fire is a risk in any industrial facility.

Type of Hazard / Risk: Human-caused: Non-Intentional and Intentional

Probability



Hazardous materials releases generally take place due to failure of a conveyance structure, during transfer from storage to processing, or during transportation. Release probability is a function of maintenance, training, procedural adherence and safety.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Hazardous materials are toxic, some in very small quantities. Additionally some used by the ADWEA companies are highly flammable even explosive. A release of these chemicals can have significant environmental impact, and can produce long-term environmental damage. Substantial economic loss is also associated with hazardous materials releases.

Most facilities have fire detection systems, fire suppression systems, and active fire brigades on the property. These measures mitigate the potential spread of fire.

Fire in a fuel storage depot could interfere with operations.

Release of gaseous chlorine could be fatal to any populations downwind from the release.

Key Consequences

(Depending on size of fire, and what burned)

Consequence Score
6 – 16 HIGH

Casualties and deaths	Minor to Catastrophic
Property damage	Minor to Catastrophic
Environmental impact	Minor to Catastrophic
Business continuity	Minor to Catastrophic

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-2; Moderate – 3-6; Significant – 7-10; High – 11-16



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SCENARIO 4

SEA WATER INTAKE DAMAGE OR CONTAMINATION

Background

Electricity is produced by a number of desalination plants that also produce potable water. Central to these production facilities is the availability of clean sea water from the Gulf. There is substantial oil and shipping traffic in the region which could potentially suffer accidents, spills, and various releases.

While a number of countermeasures are in place to prevent accidental navigation into the inlet structures, it is possible for vessels of some size to approach these structures.

The intakes are equipped with a variety of containment systems that are designed to capture and contain any contaminant before it enters the plants.

Type of Hazard / Risk: Human-caused: Non-Intentional and Intentional

Probability



The probability of a marine incident is a function of the volume of ship traffic, security controls by others, and diligent monitoring of the intake.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Damage to the intake structures of any of the production facilities would severely limit the ability for that plant to function. Depending on the cause and extent of the damage it would cause great harm to the population of Abu Dhabi and result in significant economic loss.

Contamination can also compromise the function of the plants and adds environmental impact to the equation.

Key Consequences

Casualties and deaths Severe to Catastrophic
 Property damage Severe to Catastrophic
 Environmental impact Severe to Catastrophic
 Business continuity Severe to Catastrophic

Consequence Score

9 – 16 HIGH

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
Low – 1-2; Moderate – 3-6; Significant – 7-10; High – 11-16				



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SCENARIO 5

TSUNAMI / HURRICANE

Background

Tsunami and hurricanes are rare in the southern Middle East but have occurred. Tsunami can be caused by seismic activity and Hurricanes can strengthen in the warm waters of the Arabian Gulf. Both events are capable of producing flooding, significant property damage, and can cause hazardous materials releases.

Type of Hazard / Risk: Natural

Probability

Low

Much of the Abu Dhabi area is north of the area typically impacted by such storms.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Tsunami and Hurricanes cause significant damage due to flooding and high winds. Many of the facilities are designed to withstand some water and wind, but not those typically associated with these types of storms.

Flooding can also cause releases of hazardous chemicals which can have a significant environmental impact.

Key Consequences

Casualties and deaths Minor to Catastrophic
 Property damage Minor to Catastrophic
 Environmental impact Minor to Catastrophic
 Business continuity Minor to Catastrophic

Consequence Score

4 – 8 SIGNIFICANT

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16



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SCENARIO 6

FLOOD

Background

Abu Dhabi lies along the gulf coast. While the Arabian Gulf is not prone to flooding, Tsunami and hurricanes are possible. Much of the area is flat, desert topography with limited flood and water control structures.

Type of Hazard / Risk: Natural

Probability



Much of the Abu Dhabi area is north of the area typically impacted by such storms.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Flooding causes significant injury, property damage, and potentially hazardous materials releases. Many of the facilities are designed to withstand some water, but a flood could have a major impact.

Flooding can also cause releases of hazardous chemicals which can have a significant environmental impact.

Key Consequences

Casualties and deaths	Minor to Severe
Property damage	Minor to Severe
Environmental impact	Minor to Severe
Business continuity	Minor to Severe

Consequence Score

4 – 6 SIGNIFICANT

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16



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SCENARIO 7

EARTHQUAKE

Background

Abu Dhabi is close to the Dibba Fault line. Al Ain is particularly close and would be expected to suffer greater damage, depending on the epicenter of the earthquake. The fault line has not produced an earthquake during the past hundred years and seismologists agree that such an event is increasingly likely

Type of Hazard / Risk: Natural

Probability

Moderate

The region is "overdue" for an earthquake.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Earthquakes produce severe structural damage, collapse, and have the potential to trap and kill large numbers of people. The office facilities of the ADWEA companies are in high-rise buildings in Abu Dhabi, while the plants are in a variety of locations.

A major earthquake would be expected to damage both manufacturing facilities and transmission structures. It is known that Transco has very few linesmen which would slow recovery from a widespread event.

There are a number of pipelines that move fuels and other hazardous chemicals on the plant sites. An earthquake could produce a major hazardous materials release.

Key Consequences

Casualties and deaths Severe to Catastrophic
 Property damage Severe to Catastrophic
 Environmental impact Severe to Catastrophic
 Business continuity Severe to Catastrophic

Consequence Score

9 – 12 HIGH

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16



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SCENARIO 8

TERRORIST THREATS

Background

In the technological age threats can be communicated by wired telephone, cellular phone, or the Internet. Threats can include bombs, chemicals, biological agents, radiological materials, and contamination of potable water.

The objective of the threat is to disrupt normal operations. Sometimes threats are used as tests to measure responses for a later attack, other times threats are used to retaliate for a real or perceived grievance on the part of the person making the threat.

Threats can be distressing for the employee that receives it. Threats can be exploited by the media who may inadvertently magnify the impact of a threat.

Type of Hazard / Risk: Human-caused: Intentional

Probability



It is extremely difficult to rate the probability of a threat with accuracy. Generally labor disputes, domestic situations, and some political situations can yield threats.

	Probability	Frequency
	Rare	Highly Unlikely.
	Low	Unlikely
	Moderate	Possible, more likely than not
	High	Likely

Consequence

Most threats are little more than distractions, but they all require an investigation to determine whether the threat is credible. Threats reported by the media can be magnified. Some threats can produce severe psychological impacts on the employee who receives it.

Key Consequences

Casualties and deaths	Negligible	Consequence Score 3 – 8 SIGNIFICANT
Property damage	Negligible	
Environmental impact	Negligible unless there is an over reaction to the threat	
Business continuity	Minor	

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16



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SCENARIO 9

TERRORIST ATTACK

Background

While the United Arab Emirates enjoys comparative freedom from violence, the Emirates are in close proximity to some of most volatile places in the world. A number of terrorists and malevolent actors call the Middle East home and there is a substantial amount of movement among such persons around the region.

The objectives of modern terrorists have changed and many now seek retribution for perceived wrongs, redress for old real estate issues, food, or political change. Terrorists defy conventional risk assessment as they are able to exploit vulnerabilities, change targets, and postpone attacks. Today, many terrorist attacks are conducted as part of a larger religious struggle which makes these attacks more dangerous since the terrorist is less likely to be concerned about inflicting casualties. Attacks can be calculated to distract, detonate in rapid succession, and are likely to produce casualties and significant property damage.

Explosions themselves carry significant risks of injury, death and property damage. Fires and structural damage often accompany explosions. Deliberate explosions may include a variety of hazardous substances including chemicals, shrapnel, chemical, biological, or radiological materials designed to magnify the impact of the explosion.

The military has been deployed to protect the perimeter of the production facilities.

Type of Hazard / Risk: Human-caused: Intentional

Probability

Moderate	High
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It is very difficult to predict terrorist attacks since they are crimes and the terrorists will go to great lengths to avoid detection. The companies must work closely with military and police officials to glean what they can from their intelligence services.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

A terrorist attack would cause significant casualties, could result in significant property and facility damage, could produce significant environmental impact, and might threaten the future of the companies.

Key Consequences

Casualties and deaths	Catastrophic
Property damage	Catastrophic
Environmental impact	Catastrophic
Business continuity	Catastrophic

Consequence Score

12 – 16 HIGH

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-3; Moderate - 3-6; Significant – 7-10; High – 11-16</i>				



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SCENARIO 10

SYSTEM CONTROL AND DATA ACQUISITION (SCADA) FAILURE

Background

Production and distribution of electricity and water is highly automated. SCADA controls much of the flow of water through the plants and systems. Similarly electric flow is managed and monitored in highly automated control centers.

Although the systems have limited outside access, are protected by firewalls and other security measures, they are susceptible to a variety of failures, including sabotage.

A combined physical and electronic attack on a utility structure could have devastating consequences.

Type of Hazard / Risk: Human-caused: Intentional

Probability

Low

SCADA systems are typically mirrored, backed up, and are set to operate in default condition in the event of a failure.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

While the systems are highly automated, they can be operated manually. Doing so would be challenging for the companies, but is possible.

SCADA failure could compromise ability to manage the broader system and if coupled with a physical attack could be devastating for the operation.

SCADA systems have also been attacked by disgruntled employees.

Key Consequences

Casualties and deaths	Minor
Property damage	Minor
Environmental impact	Severe
Business continuity	Severe

Consequence Score
4-6 MODERATE

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H

Low – 1-3; Moderate - 3-6; Significant – 7-10; High – 11-16



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SCENARIO 11

COMMUNICATIONS FAILURE

Background

Communications are critical to the operation of any company. The ADWEA companies rely on a variety of communication platforms, particularly cellular telephones, to communicate among the various operating units.

Some operating companies have radios, but not all. There is no coordinated communications strategy among the operating companies.

The separate nature of the operating companies mitigates the risk of a global communications failure as each uses a different system and platform.

Type of Hazard / Risk: Human-caused: Non-intentional and Intentional

Probability



Communications systems are mirrored, and the companies use different systems and equipment. This diversity lessens the likelihood of a global communications failure.

	Probability	Frequency
	Rare	Highly Unlikely.
	Low	Unlikely
	Moderate	Possible, more likely than not
	High	Likely

Consequence

A global communications failure would make operation of the combined companies difficult. Consequences could be most severe for the distribution companies and the trading company, although the operating companies and distribution companies have default conditions that they can use for a period of time.

There is inherent redundancy in communications systems.

Key Consequences

Casualties and deaths	Negligible
Property damage	Negligible
Environmental impact	Negligible
Business continuity	Minor

Consequence Score

2 – 4 MODERATE

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-2; Moderate – 3-6; Significant – 7-10; High – 11-16</i>				



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SCENARIO 12

EPIDEMIC

Background

Disease can be spread through casual contact, air systems, and through travel. Abu Dhabi is a growing city with tremendous influxes of people from around the world. This makes the Emirate at some risk for transmission of disease. Moreover it is well known that a number of terrorist groups and nation states have access to weaponized biological agents.

Type of Hazard / Risk: Natural

Probability

Moderate

Epidemiologists estimate that outbreaks of disease are likely in industrialized countries. This can be exacerbated by the import of workers from foreign countries. Terrorists are known to possess some biological weapons and some groups in the region have threatened their use.

Probability	Frequency
Rare	Highly Unlikely.
Low	Unlikely
Moderate	Possible, more likely than not
High	Likely

Consequence

Disease is problematic because it manifests itself most frequently as "common colds or flu" Some deadly contagious diseases can creep into environments carried by unwitting infected persons.

An epidemic could compromise operations by impacting availability of trained workers.

Key Consequences

(Depending on illness)

Casualties and deaths Severe to Catastrophic
Property damage Negligible
Environmental impact Minor
Business continuity Minor

Consequence Score

3 – 12 HIGH

Probability	Consequence Scoring			
	Negligible (1)	Minor (2)	Severe (3)	Catastrophic (4)
Rare (1)	1 – L	2 – L	3 – M	4 – M
Low (2)	2 – L	4 – M	6 – S	8 – S
Moderate (3)	3 – M	6 – S	9 – S	12 – H
High (4)	4 – M	8 – S	12 – H	16 – H
<i>Low – 1-2; Moderate - 3-6; Significant – 7-10; High – 11-16</i>				

D.3. Results

Table 4 summarizes the rankings of the hazards evaluated in this report, as they apply to ADWEA's corporate needs.

Table 4 – Identified ADWEA Risks and Ranking

LOW 1-2	MODERATE 2-4	SIGNIFICANT 6-8	HIGH 8-16
	Communications Failure (2-4)	Tsunami/Hurricane (4-8)	Fire (6-16)
		Flood (4-6)	Explosion (9-16)
		Terrorist Threat (3-8)	Hazardous Materials Release (6-16)
		SCADA Failure (3-6)	Sea Water Intake Damage or Contamination (9-16)
			Earthquake (9-12)
			Terrorist Attack (12-16)
			Epidemic (3-12)

ADWEA's Risk Management Plan shall address all the Scenarios identified as having Significant and High Consequence Scores.