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*An emerging issue*

## Disaster preparedness for water utilities

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**Introduction.** The number of people affected by natural disasters has been increasing million per year to 211 million since 1991 to 2000. More than 665,000 people died in 2 natural disasters, 90 percent of which was water related. Of this water-related disaster accounted for about 50 percent, water borne diseases about 28 percent and droughts percent.

It is projected that water-related crisis will not abate anytime soon. The off-coast earthquake in Ind the tsunami that it generated is one of the most devastating in recent years. Though spared of that cataclysmic event due to geographical factors, the Philippines also had its share of water-related dis Thousands died in the floods and landslides caused by typhoons and landslides in the provinces of C Nueva Ecija, Aurora and Pampanga.

The current year was met by disasters of the man-made type. The Valentine bombings highlighted t vulnerabilities of soft targets which the terrorists may exploit willfully anytime. There is increasing c that drinking water utilities may also be targets of attacks. The Philippines Task Force on Security of Infrastructures (TFSCI) ranked water supply among the top of the eleven possible targets of terroris Today, it is no longer a question of whether natural, accidental, and intentional disasters will occur. question is when will they occur.

### Disasters and Their Effects on Drinking Water Supply Systems

**Disasters impede development.** From 1970-2000, the Philippines incurred an annual damage of due to disasters. In 2004, costs due to disasters exceeded P33.5 Billion.

Water supply systems are vulnerable to sudden unpredictable disasters from natural and man-made Several earthquakes have adversely affected, water sources and have caused damage to pipelines. Santos City WD experienced increased pipe breakages along their transmission lines whenever a sp earthquakes will occur in the area. The Mt. Pinatubo eruptions in 1991 partially or completely disabl water systems of some municipalities in Pampanga, Zambales and Tarlac. Mt. Mayon's eruptions ha constantly affected the sources and operations of the water districts in the immediate vicinity. Incid cholera and typhoid fever are becoming more frequent and one of the causes of the outbreaks has k attributed rightly or otherwise to the local water districts.

Fortunately, there have been no documented terrorists attacks on water supply facilities in the mag will affect the services as yet. However, water supply systems have certain characteristics that mak vulnerable to terrorists attacks: the system covers a large area that may not be monitored by the V times and; the system have components that are vulnerable to sabotage, for example, isolated rese pumping stations.

Generally there are (2) two types of disasters that we have to contend with and prepare for: (1) Na

Disasters. Urban infrastructure is highly vulnerable to natural disasters. Failures of these structures, water supply and other pipeline systems will most likely result to major impacts in terms of human and economic losses. Natural disasters can be any or combination of the following: (a) Typhoons. In the from Nov. to Dec. of 2004 only, four typhoons brought havoc to southern Philippines: Uning, Violet and Yoyong. (b) Floods (c) Heavy monsoon rains (d) Tsunamis (e) El Nino (f) Droughts (g) Biological (micro-organisms, insects or vermin infestations) (h) Earthquakes. The Philippines experience 5 qu or 1,825/year and (i) Volcanic Eruptions. (2) Man-made. Damage to or destruction of water supply by terrorists attack can disrupt the delivery of vital human services, threaten public health and may cause loss of lives. Some man-made disasters are: (a) Acts of war and terrorism (b) Vandalism (c) Explosions (e) Chemical spills (f) Power failures (g) Systems Failures and (h) Accidents.

Disasters in the operations of the water utilities may also occur due to neglect and/or failure of the organization to properly institute and adhere to maintenance procedures.

The issue now is whether the utilities can respond to disasters to avert its negative effects on water due to contamination of water supplies, prolonged discontinuity of service, loss of fire-fighting capability, release of chlorine in the air among others

### **Disaster Preparedness and Risk Mitigation (DPRM)**

Generally, most water utilities have no emergency response plans in place that should reduce the risk of water supply shortage and interruptions and water quality deterioration both due to natural and man-made disasters. The lessons learned by the water districts on their experience with disasters do not accrue available knowledge on the subject.

Contaminated water has its direct and indirect consequences. Change in water quality and very limited availability of water supply affect customers' preferences and behavior. Consumers are now developing preference to bottled water instead of water from the taps. Every breakdown in the water district or resulting to reduced efficiencies are arguments that justify the shift to bottled water by consumers.

There's a need to properly and accurately document cholera outbreaks. In the provinces of Pangasinan and Camarines Sur, these health problems were initially and incorrectly attributed to public water supply. Although the water quality deterioration was traced ultimately to shallow private wells and other factors such as poor hygienic practices, the initial negative perception of the public on the water utilities is both damaging to morale. Likewise, the responses of several agencies, both private and government to this tragedy and similar events must be reviewed with the end of formulating and institutionalizing a better response to these emergencies.

The coping capability of the Legazpi City, Tabaco and Daraga water districts which are located at the foot of the Mayon Volcano on the phenomena of shifting river flows and irregular spring sources yield will provide insights in their response to similar crisis.

### **Status of DPRM in other countries**

1. The US Federal Public Health Security and Bioterrorism Preparedness and Response Act (Bioterrorism Act) June 2002 requires all community water systems that serve 3,300 or more persons to prepare a Vulnerability Assessment (VA) of their system. It must cover all aspects of the system including computer systems.
2. Homeland Security Presidential Directive 7 of US President George W. Bush establishes a national policy under which critical infrastructures including drinking water "systems are to be protected from terrorists attacks.
3. Field testing of the WHO Guidelines to Assess National Health Capacity to the Deliberate, Unintentional, Biological and Chemical and Radionuclear Materials (BCRN) were conducted in some selected countries including the Philippines wherein field testing was conducted last February 2-21, 2005

Metro Manila and Davao.

The events of 9/11 accelerated the development of programs required to mitigate the vulnerabilities drinking water utilities in developed countries. Drinking water utilities are held responsible for providing and reliable supply of potable water to their concessionaires with or without a disaster.

## Status of DPRM in the Philippines

### Agencies Involved in Disaster Preparedness and Risk Mitigation

1. **Cabinet Oversight Committee on Internal Security (COC-IS)** - Handles crisis situations at the national level that evolve into national security concerns.
2. **National Peace and Order Council** - Handles crisis situations arising from peace and order.
3. **National Disaster, Coordinating Council- PD 1566** - Responsible for strengthening the Philippine Disaster Control Capability and Establishing the National Program on Community Disaster Preparedness.  
Advises the President on the status of National Disaster Preparedness and Management Plans. Recommends to the President the declaration of State of Calamity and release of National Calamity Fund as needed.
4. **Office of Civil Defense - LOI 19, S-1972**  
Has the primary task of coordinating the activities and functions of various government agencies and instrumentalities, private institutions and civic organizations for the protection and preservation of life and property during emergencies.
5. **Task Force for the Security of Critical Infrastructure (TFSCI)** - Integrates and codifies initiatives, programs and procedures to protect critical and vital infrastructure within the framework of the government's counter terrorism policies.

**Identified Critical Infrastructures:** (a) Energy (b) Water Supply (c) Information and Communication (d) Transportation (e) Banking and Finance (f) Public Health (g) Emergency Services (h) Agriculture and Food (i) Manufacturing (j) Government Services and (k) Strategic Commercial Centers.

6. **Metropolitan Waterworks and Sewerage System** - Both Manila Water and Maynilad have their respective Emergency Response Plans. These operational plans are monitored and evaluated by the MWSS Regulatory Office.

Manila Water has a group called Risk, Crisis and Asset Management Cluster or the RCA Cluster. The objective is to make Manila Water, as an organization, aware, prepared and ready for any crisis and emergency that will affect their services. The programs instituted by the Manila RCA Cluster consist: Risk Management (2) Crisis Management and (3) Asset Management.

Maynilad Water is currently focused on consequence management to mitigate the effects of the two they are currently facing: the effects of low water supply due to less rainfall and the reduced flow from Umiray sources brought about by the clogging of the 3.00 meter aqueduct with logs and debris. The program on the disconnection of illegal connections and apprehension of booster pump users comprise their over-all program to improve the services.

### Selected Water Districts (WDs)

**Zamboanga City WD.** A comprehensive Disaster Preparedness and Consequence Management is in place and constantly updated to meet evolving threats to both the WD facilities and personnel. The Emergency

Response Plan has varied activities that include foot patrols in the watershed to tankering of water to pressure zones. A strong feature of their ERP is the very strict enforcement of limited access of unauthorized personnel to important facilities and the complete video coverage of high risk areas.

**Urdaneta City WD.** After the high incidence of amoebiasis wherein the WDs were wrongly blamed for the tragedy, the WDs in Pangasinan led by UCWD strengthened their institutional partnership with the LGU. The LGU provided assistance to the affected areas that rely on shallow private wells for their water needs. A sustained media support played an important role in the information dissemination during the crisis.

**San Jose del Monte City WD.** This WD has a Quick Reaction Team that is tasked to implement the Disaster Preparedness and Risk Mitigation Plan. Although a composite team from different operating units of the WD, the operational capabilities of the team are further enhanced by their training as reserve of enlisted men of the Armed Forces of the Philippines Army Affiliated Reserve Unit (AFPAARU).

## Recommendations

The development of an ERP for water utilities, including the water districts; is becoming imperative. The impact of disasters on water supply and sanitation systems, may be significantly reduced and the recovery of these systems may be accelerated by adopting the following measures:

1. Preparation of Disaster Preparedness and Risk Mitigation Plan - improved response to crisis will benefit the water districts through early restoration of services and consequently renewed trust and confidence of the consumers.
  2. Development of Vulnerability Assessment tools especially for the big to very large water districts are imperative in view of the great impact on the daily lives of the citizenry if the water supply systems become targets of man-made harmful acts.
  3. Preparation of Vulnerability Assessments (VA) - at a minimum, the VA must cover the entire system including computer or other automated systems. A VA may have the following sections: (a) System description and history; (b) Major Threats Review (man-made and natural disasters); (c) Existing Deterrents and Detection Methods; (d) Site Specific Review; (e) Risk Assessment; (f) Response and Recovery Methods and (g) Recommendations for Improvements. (from Comprehensive Environmental. Inc. Technical Report).
1. System Description and History- a review of pipes and conveyances, physical barriers, water collection, pretreatment, treatment, storage and distribution facilities, electronic, computer systems controlling the water systems, use and handling of chemicals.
  2. Major Threats Review- threats that will substantially disrupt the ability of the system to provide a safe and reliable supply of drinking water or otherwise present significant public health concern.
  3. Existing Deterrents and Detection Methods.
  4. Site Specific Review. Water supply shortages are not always due to calamitous events or terrorism. Gaps in water supply and demand may be due to the overall inability of policy makers and management to foresee the requirements of the served population and were remiss in their task of identifying new resources for their growing population. The VA will identify disasters according to:
    - a. Natural
    - b. Man-made (not deliberate). Lack or poor maintenance- contamination may occur due to poor maintenance and/or lack of monitoring to identify potential points of

contamination of the WDs facilities. Operational lapses. Accidents.

c. Malevolent Acts. Physical disruption. Actual damage to pump stations, pipelines and other facilities that reduces capability of WD to deliver water services to its constituents. Bioterrorism/chemical contamination. Contamination of water supply. Cyber Attacks- can affect SCADA and other platforms in the WD computer systems.

5. Risk Assessment- define risk in terms of the following three basic questions: (1) What can go wrong (scenario)?, (2) Will it happen (likelihood)? and (3) If it happens, does it matter (consequences)? The steps may include the following: (a) Planning (b) Threat Assessment (c) Characterization (d) Consequence Assessment (e) System Effectiveness (f) Risk Analysis. Water Distribution System is one of the most vulnerable component of a WSS. (a) Identification of contamination and (b) Minimize further spread of contamination. Pumping Stations- could be protected better by installing them below grade. Reservoirs- especially the open ones may be contaminated by bird droppings, decomposing leaves or insects. On-site Guard Force- enhance physical security. Technological Adaptations- development of specially manufactured large diameter flexible polyurethane hose to interconnect damaged transmission lines. Real-time monitoring of water quality in every phase of the water supply production to delivery. Site stocking of frequently damaged components, i.e., pipes;

6. Response and Recovery Methods- restoration of levels of service with appropriate quality is vital lifeline with topmost priority in any crisis situation and the prompt availability of potable fire-fighting water is fundamental prerequisite to mitigate the impacts of any crisis. (a) Framework for clean-up and recovery and (b) Improved Response Protocols- addresses the actions to be taken before contamination occurs

## Other Protective Measures

1. Bottling Capabilities for WDs - besides providing potable water, WDs should now embark on making water portable and handy. (a) The changing life-style of people requires them to be with their own bottled water. And (b) Emergency need for water can only be acted immediately by shipping or transporting bottled water.

2. Public Information - incident reports, operations center, an official spokesperson should be designated. Will include issuances of public/consumer precautionary measures and advisories such as Boil Water Advisories and installation of signage to the effect.

3. Coordination with other agencies and/or institutions - adequate institutional and organizational arrangements should be undertaken as may be necessary. There must be clearly defined roles, common terminology, mutual assistance plans among the entities involved in the endeavor. Information exchange among the agencies should be enhanced by internet interactive information exchange system. (1) Local Government Units (2) Philippine National Police (3) Media (4) Local Water Utilities Administration (5) Manila Water (6) Maynilad (7) Water Districts (8) National Disaster Coordination Center (9) Office of Defense (10) Philippine National Red Cross (11) Bureau of Fire Protection (12) Telecommunications Companies (13) Amateur Radio Associations (14) Department of Health (15) Department of Public Works and Highways (16) Power Providers (Meralco, Electric Cooperatives, Suppliers of generator sets) (17) PAGASA (18) National Water Resources Board (19) Department of Science and Technology and (20) Department of Environment and Natural Resources.

## Countermeasures Against Terrorism

### 1. Physical Counter measures

- a. Free access to water reservoirs should be limited or eliminated
- b. Security fencing for pumping stations, intakes, treatment plants must be constructed in such a way as to prevent unauthorized access.

way that vandalism will be eliminated.

- c. Intrusion Alarms should be installed to notify authorities that intruders are trying- to gain access or have already entered limited access areas.
- d. Installation of cameras with recording capabilities of at least eight hours.
- e. Communication facilities to include landline, radio and cellphones
- f. Immediate shut down mechanisms to stop operations or limit contamination immediately.
- g. Maintain a back-up equipment pool with other water districts.

## 2. Chemical Counter measures

- a. Maintain chlorine residual in the system always.
- b. Add parallel raw water supply pipeline from intake to water treatment plant and parallel finished water transmission lines from the WTP to the main distribution pump station.
- c. Provide back-up filter wash water supply when back wash tank is taken offline.
- d. Install on-line 'chlorine residual monitors at strategic locations on the distribution system to in mitigating biological and chemical contamination of water supply.
- e. Install fish-test aquarium at every essential point of the water production process.

## 3. Institutional Countermeasures

- a. Coordinated emergency response and coordinated communications among concerned agen
- b. Adopting a system of standardization that encourages cooperating agencies to use commor terminology.
- c. Development of partnerships/networking among government and private agencies to devise mutual assistance plans.
- d. Communication and Coordination
- e. Research
- f. Inclusion of security measures In future projects.

## LWUA's Role in DPRM

1. Policy review and formulation on disaster preparedness and risk mitigation for the water utilities :
2. Issue guidelines on requiring WDs to prepare Emergency Response Plans.
3. Issue advisory on early warning alerts as provided by the TFSCI or other authorities.
4. Serve as information center for incidents of disasters, threats and risks in the WDs.
5. Conduct workshops on ERP in cooperation of other agencies and WDs- main outcome will be docu be used as templates that can be modified by water districts to suit their needs.
6. Assign 501st LWUA Water Battalion as the Emergency Response Team to assist water districts.
7. Assist in the training of water district personnel as members of AFP AARU.

**Template of an Emergency Response Plan (ERP)** - a written plan establishing operating proced handling water supply emergencies. The plan shall include provisions for emergency water supply in sudden loss of existing sources, natural and man-made. It also shall specify who does what and wh available resources, during emergency situations.

## Recommended Outline:

- A. Disaster Effects: (a) Natural Disasters and (b) Man-made: Malevolent Acts and Non-intentional
- B. Vulnerability Assessment

1. Vulnerability: (a) Contamination (b) Water Main Breaks (c) Fuel/Chemical Spills (c) Power Outages (d) Drought (e) Typhoons (f) Vo1canic Eruptions (g) Equipment Breakdowns (h) Fires/Explosions (i) Vandalism/Terrorism (j) Floods (k) El Nino and (l) Earthquakes.

2. WSS Components: (a) Watersheds (b) Aquifers (c) Sources (d) Dams (e) Transmission Systems (f) Reservoirs (g) Chemical Storage (g) Personnel (h) Power Systems (i) Pumping Stations (j) Vehicles (k) Communication Equipments and (l) Computer and Control Systems.

3. Disaster Characteristics

4. Water Requirements Under Disaster Conditions

5. Functional Operation

6. Identification of Critical Components

#### C. Protective Measures

1. High Probability Effects and Countermeasures: (a) Contaminatign, (b) Power Outages, (c) Communications Breakdown, (d) Transportation Failure, and (e) Damage to Facilities.

2. Other Effects and Countermeasures

3. Consideration of Security Requirements in Plant Design

4. Protection of Personnel

#### D. Emergency Operations Planning

1. Assumptions of Emergency-caused effects- differentiate emergency situations according to following criteria (based on the Handbook for Water Supply Emergencies. Massachusetts 2002

(a) Level 1- Routine Problems. Minor disruptions to the WSS affecting 10% or less of the system and can be repaired within 24 hours.

(b) Level II- Alert/Minor Emergencies. Significant disruptions to the WSS that affect 50% or less of the system and can be repaired within 72 hrs.

(c) Level III- Major Emergencies- Significant disruptions to the WSS that affect more than 50% of the system and would require more than 72 hrs. for repairs. This may require a Declaration of Water Supply Emergency and/or a Boil Water Order or Do Not Drink Order or Do Not Use Order.

Level IV-Natural Disasters- disruptions in the WSS that affect more than 50% ofth~ system and requiring more than one week to restore services. May also require a Declaration of Water. Supply Emergency and/or a Boil Water Order or Do Not Drink Order or Do Not Use Order.

(e) Level V-Terrorists Acts/Others- disruptions due to deliberate acts that impair a WSS and/or uncontrolled release of Biological, Chemical and Radionuclear Agents (BCRN). Will most likely require a Declaration of Water Supply Emergency and/or a Boil Water Order or Do Not Drink Order or Do Not Use Order.

2. Estimate Remaining Capabilities

3. Estimate Community Water Requirements
4. Match Capabilities to Requirements
5. Specify Priorities
6. Assignment of Specific Tasks

### Conclusion

A water supply operation encompasses a multitude of vulnerabilities and risks. Both the Policy-makers and Management are expected to focus their collective energy, talents and resources towards guaranteeing a continuous uninterrupted supply of potable water to the public even at times of emergency conditions, responding to the situation appropriately and responsibly. A well prepared Emergency Response Plan manifests that commitment. We protect the health and safety of our citizenry when we protect our water supply facilities. 