MMEI RS Scenario 8:

Magnitude 7.2 Earthquake along the West Valley Fault System

JANE T. PUNONGBAYAN, Ph.D.
Philippine Institute of Volcanology and Seismology
Department of Science and Technology

UN OCHA MTG; RCBC 18 Feb 2011
2010 January 12   Port-au-Prince, Haiti     Magnitude 7.0

Presidential Palace
2010 Feb 27 Chile    Magnitude 8.8

REUTERS/Marco Fredes)
IS THIS POSSIBLE IN METRO MANILA?

YES
ARE WE NEXT?

Not Necessarily.

What happened in Haiti and Chile has nothing to do with the system of faults in the Philippines

BUT!

Philippines is ALWAYS threatened by a large earthquake because of its tectonic setting
Earthquake Impact Reduction Study for Metropolitan Manila (MMEIRS) 2002 - 2004

Goals:
1) Evaluate seismic hazards, damages and vulnerability of MMIa
   - considered 18 earthquake scenarios
   - evaluated potential effects to buildings, lifeline, population

2) Prepare framework of master plan for earthquake disaster management

Implemented by:
Japan International Cooperation Agency (JICA)
Metropolitan Manila Development Authority (MMDA)
Philippine Institute of Volcanology and Seismology (PHIVOLCS)

In cooperation with NDCC agencies and other stakeholders
MMEIRS: There are several “BIG ONES” for Metro Manila

<table>
<thead>
<tr>
<th>Model</th>
<th>M</th>
<th>Characteristics</th>
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</thead>
<tbody>
<tr>
<td>08 – West Valley Fault</td>
<td>7.2</td>
<td>Severe Damage</td>
</tr>
<tr>
<td>13 – Manila Trench</td>
<td>7.9</td>
<td>Tsunami</td>
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<tr>
<td>Model</td>
<td>Model 08</td>
<td>Model 13</td>
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<tr>
<td><strong>Magnitude</strong></td>
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<td></td>
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<tr>
<td></td>
<td>7.2</td>
<td>7.9</td>
</tr>
<tr>
<td><strong>Generator</strong></td>
<td>West Valley Fault</td>
<td>Subduction along Manila Trench</td>
</tr>
<tr>
<td><strong>Seismic Intensity (PEIS)</strong></td>
<td>VIII - for most of MetroManila, IX - alongside Marikina River and Manila Bay</td>
<td>VIII - West of Metromanila VII - other areas</td>
</tr>
<tr>
<td><strong>Tsunami possibility</strong></td>
<td>NONE</td>
<td>Maximum 4m average 2m alongside Manila Bay</td>
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</tbody>
</table>
HOW STRONG IS SCENARIO 08?

• A magnitude 7.2 is similar to 50 Megatons of TNT; equivalent to that of **Tsar Bomba** (50 megatons), the largest thermonuclear weapon ever tested.

• Haiti case: epicenter some 10km from Port-au-Prince.

• Scenario 08: Epicenter WITHIN MetroManila.

The West Valley Fault is right in our backyard. NDCC Opcen is about 1.8 km away from the fault; PHIVOLCS only 3 km away.
ATTENDANT HAZARDS

GROUND RUPTURE

GROUNDSHAKING

LIQUEFACTION

LANDSLIDES

FIRE
Metro Manila cities transected by the West Valley Fault

1. Quezon
2. Marikina
3. Pasig
4. Makati
5. Pateros
6. Taguig
7. Muntinlupa

Fault Mapping by PHIVOLCS
Road cut
Area separation

Fault crossing the Dalton Pass road at km 201 + 400. Courtesy of DPWH and Katahira.
ESTIMATES OF MAXIMUM INTENSITY OF GROUNDSHAKING
Scenario 08: M=7.2

- PEIS HIGH VIII (brown) for most of MetroManila

- PEIS IX (red) for areas near the fault or underlain by soft sediments
PHIVOLCS Earthquake Intensity Scale (PEI S)

I  - Scarcely Perceptible
II - Slightly Felt
III - Weak
IV - Moderately Strong
V  - Strong
VI - Very Strong
VII - Destructive
VIII - Very Destructive
IX - Devastating
X  - Completely Devastating
What to prepare for: INTENSE GROUND SHAKING
Earthquake of Kobe, Japan 1995
1995 Kobe Earthquake
Hyatt Hotel in Baguio City after the magnitude 7.8 earthquake of July 16, 1990

MMEIRS: 4 out of 10 buildings will be damaged or collapsed
BUILDING DAMAGE ESTIMATES

Magnitude 7.2 Earthquake from the West Valley Fault
Metro Manila Earthquake Impact Reduction Study (JICA-MMDA-PHIVOLCS)

• ~ 40 % of the residential buildings
  * 175,000 – heavily damaged
  * 345,000 – partly damaged

• ~ 38 % of the 10-30 story buildings

• ~ 14 % of the 30-60 story buildings

• ~ 28-35 % of public buildings
  * 8-10 % - heavily damaged
  * 20-25 % - partly damaged
BUILDING DAMAGE ANALYSIS

Legend

Heavily Damaged Number
- 1 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- 500 - 3000

Emergency Road Network
- Primary
- Secondary
- Railways

Sources: MMEIRS 2003
Liquefaction: The ground loses strength and structures built on top of it may sink or tilt...

At risk are places with high water content

LATERAL SPREADING

Lateral spreading in Brgy. Patong, Hinunangan
July 19, 2007 earthquake

Mindoro 1994

JULY 16, 1990 EARTHQUAKE

PHIVOLCS
Liquefaction Potential (Scenario 08)
Landslide

Guinsaugon case:
Water-saturated slopes fail easier;
lower magnitudes might trigger landslides
FIRE SPREAD ANALYSIS

FIRE: A Secondary Hazard:

Legend
- Possible Areas of Fire Spread
- Fire/Explosion Hazards
- Gasoline Stations
- Fire Prone Areas
- Wide Road
- Wide River
- Railways

Sources: MMEIRS 2003
DAMAGE ESTIMATES
Number of Deaths Analysis (Scenario 08)

Legend

Number of Deaths
- 0 - 200
- 200 - 500
- 500 - 1000
- 1000 - 2000
- 2000 - 5000
- 5000 - 10000

Emergency Road Network
- Primary
- Secondary
- Railways

Sources: MMEIRS 2003
Death Ratio

Legend

Death Ratio (%)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.7

Emergency Road Network

- Primary
- Secondary
- Railways

Sources: MMEIRS 2003
Failed Bridges/Flyovers

- Cars lie overturned after the highway they were travelling on was destroyed in an earthquake in Santiago February 27, 2010. (REUTERS/Marco Fredes)

2010 Feb 27 Chile
Magnitude 8.8
Picture taken on March 1, 2010 of telephone and power lines brought down in Concepcion, Chile, by the 8.8-magnitude earthquake three days earlier. (EVARISTO SA/AFP/Getty Images)
Electric Powerline Damage Analysis
(scenario 08)

Legend

<table>
<thead>
<tr>
<th>Damage Length (m)</th>
<th>Color</th>
</tr>
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<tbody>
<tr>
<td>0 - 30</td>
<td>Light Blue</td>
</tr>
<tr>
<td>30 - 60</td>
<td>Green</td>
</tr>
<tr>
<td>60 - 90</td>
<td>Yellow</td>
</tr>
<tr>
<td>90 - 120</td>
<td>Brown</td>
</tr>
<tr>
<td>120 - 180</td>
<td>Red</td>
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Emergency Road Network
- Primary
- Secondary
- Railways

Sources: MERALCO, 2003
WATER PIPELINE DAMAGE ANALYSIS (scenario 08)
Main Areas of concern/ Frameworks for the Earthquake Impact Mitigation (MMEIRS Final Report Ch.3)

- NSD-1: Protect stability of Nat’l Govt.
- NSD-2: Protect stability of socio-economic System
- RMS-8: Fire suppression and hazardous material abatement
- RMS-9: Evacuation Route and Evacuation Sites
- RMS-10: Water, Food and other necessities
- RMS-11: Emergency Health and Medical Response System
- RMS-12: Emergency Transportation Network
- RMS-12: Search and Rescue
- RMS-13: Information and Communication System
- RMS-14: Establish Information System (GIS)
- RMS-15: Manage Emergency Public Information
Most of the medical facilities, even if undamaged, will not be very useful during the first few hours after the quake.
Hundreds of felt aftershocks will follow

MMEIRS estimates there will be 3.15 million refugees after the M7.2 quake.
Residents try to force their way into a supermarket to buy food and essentials as police try to keep order after an earthquake in Concepcion February 28, 2010. (REUTERS/Jose Luis Saavedra)
Residents loot a supermarket after an earthquake in Concepcion February 28, 2010.

Chilean rescuers used shovels and sledgehammers on Sunday to find survivors of a huge earthquake in Chile that unleashed a Pacific tsunami and triggered looting by desperate and hungry residents. (REUTERS/Jose Luis Saavedra)
Residents collect water from children's swimming pools, as the potable water system remains broken, after a major earthquake in Concepcion, Chile on March 1, 2010. (REUTERS/Jose Luis Saavedra)
Clearing of debris
Another task: mass casualty management

Magnitude 7.0 2010 Jan. 12 Port-au-Prince, Haiti Dead: 200,000+

2009 April 6 Aquila, Italy Magnitude 6.3 dead: 260+
Possible Regional Separation:

- **West**
  - Fire, Building Damage

- **North**
  - Bridge Damage

- **South**
  - Bridge Damage

- **East**
  - Building Damage, Bridge Damage
Local government units on their own for the first few hours and days after the quake

Ex. QUEZON CITY will have to handle a lot

- City Population: 2.68 Million

- Brgy. Commonwealth (172,338) & Batasan Hills (148,621) have each a population bigger than City of San Juan (125,338) and Pateros (61,940)

- City’s growth rate over 7 yrs almost equals the population of Makati (510,383) and surpasses that of Marikina (424,610)

*Info Source: QC website*
NEARBY PROVINCES WILL ALSO BE AFFECTED

- Int. VIII and above
- Int. VII
- Int. VI
- Int. V and below

Provinces affected: Cavite, Bulacan, Rizal, Laguna.
WHEN WILL IT HAPPEN?

• NO one knows

• What science knows is, the return period of this earthquake is estimated at about 200 - 400 years and that no large earthquake has happened in the West Valley Fault since the 1700s. The last significant event was in 1658 (350+ years ago)
The response agencies must at all cost remain effective and efficient during this crisis.

BON COURAGE!