Preparedness for Maritime Community
Tsunami Planning for Ports and Harbours
USA and Japan Examples

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Outline – Ports and Harbors

- Establishing thresholds – Hawaii, Guam
- Evacuation Plans and Protocols - Guidelines and Manuals, Response Checklists, Playbooks
- Awareness
Marine Preparedness - Tourism and Cruise Ships

18 Nov 1867
M7.5
24 deaths
USVI:
4.9-15.2m

M9, Northern Puerto Rico Trench

Ocean Surface Elevation (meters), Time Post-EQ (hrs) = 0

Tsunami Currents (knots), Time Post-EQ (hrs) = 0

P. Lynett, USC
Tsunami Safety Products for Hawaii and Guam

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Maritime Hazard Modeling & Mapping

Maritime and Scientific Community Input
• USCG, PTWC, HDOT, Matson, Sause, Foss (Young Brothers), Kirby, and Pilots Association
• Hawaii Earthquake and Tsunami Advisory Committee
• National Tsunami Hazard Mitigation Program

Data Products
• Offshore currents - Mw 9.3 / 9.6 Aleutian scenarios for safe zones
• In-harbor hazard maps of current, surge & drawdown for advisory-level tsunamis

Database of scenarios
• Three major subduction zones
• Earthquake at 0.1 Mw increments up to ~2 m nearshore wave amplitude
• Modeling of all events at mean-sea level

K.F. Cheung, Univ of Hawaii
Exclusion Area: ½ NM either side of Hotel Buoy at a bearing of 028° for 3 NM (HNL Hbr Range)
Computational Grids

K.F. Cheung, Univ of Hawaii
Digital Elevation Model

High Resolution Data
- FEMA, USACE, and DHS LiDAR topography (1 m resolution)
- NASA SRTM topography (30 m)
- USACE LiDAR bathymetry (3 m)
- SOEST multibeam data (50 m)

Modification of DEM
- US Army Corps survey data
- Pile supported docks

K.F. Cheung, Univ of Hawaii

Hawaii Department of Transportation
## Summary Table for Aleutian Tsunamis

<table>
<thead>
<tr>
<th>Earthquake Magnitude</th>
<th>Water Surface Rise/Fall</th>
<th>Water Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surge from Mean High Water (feet)</td>
<td>Drawdown from Mean Low Water (feet)</td>
</tr>
<tr>
<td>7.6</td>
<td>0.6</td>
<td>-0.7</td>
</tr>
<tr>
<td>7.7</td>
<td>0.8</td>
<td>-0.9</td>
</tr>
<tr>
<td>7.8</td>
<td>1.0</td>
<td>-1.2</td>
</tr>
<tr>
<td>7.9</td>
<td>1.3</td>
<td>-1.5</td>
</tr>
<tr>
<td>8.0</td>
<td>1.8</td>
<td>-2.0</td>
</tr>
<tr>
<td>8.1</td>
<td>2.2</td>
<td>-2.4</td>
</tr>
<tr>
<td>8.2</td>
<td>3.0</td>
<td>-3.3</td>
</tr>
<tr>
<td>8.3</td>
<td>3.6</td>
<td>-4.3</td>
</tr>
<tr>
<td>8.4</td>
<td>4.7</td>
<td>-4.7</td>
</tr>
</tbody>
</table>

### Important 3 data products

- Surge, drawdown, and current

### Tsunami scenarios – Honolulu, Oahu

- Mw 9.3 & 9.6 Aleutian, Mw 7.7-8.4 Aleutian
- Mw 8.1-9.0 Kamchatka, Mw 8.3-9.2 Chile: Oahu
Guam - Community Input and Participation

Site visits and meetings with local communities to define data products (January 16 – 18, 2018)

USCG Sector Guam
• Integration of advisory-level tsunami scenarios into its severe weather plan
• Coordination with Port Authority of Guam and Naval Base Guam in plan development
• Consultation with USCG Sector Honolulu, which has already incorporated tsunami scenarios into its severe weather plan

Guam Power Authority
• Utilization of extreme tsunami scenarios in impact assessment of its power plant and fuel storage as well as siting of new facilities at Apra harbor

Guam Waterworks Authority
• Utilization of extreme tsunami scenarios in vulnerability assessment of wastewater treatment plant at Agana Bay
Preparedness for Maritime Community
Tsunami Planning for Ports and Harbours – Japan

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Sample Results based on the 2011 Tohoku Tsunami

Surge

Drawdown

Current

Surface Elevation (cm)

Amplitude Spectrum (cm·s)

Elapsed Time (hours)

Period (min)
International SOLAS

Handbook for making tsunami evacuation manual – Ship Operators

Study Meeting for Improving Ship Evacuation during Tsunami
Ministry of Land, Infrastructure and Transport
March, Heisei 26 (2014)

Introduction
• Utilization of creation guidance
• How to prepare ship tsunami evacuation manual
• Large-scale earthquake targeted for consideration at the Cabinet Office Central Disaster Prevention Council
• Assumption of damage of tsunami caused by a large-scale earthquake
• Tsunami evacuation manual preparation Structure of guidance

I Collection of earthquake and tsunami information
1. Information to be collected at the occurrence of the earthquake (Meteorological Agency Presentation Information)
2. Tsunami information to be grasped in advance

II Determine the status of the ship at the time of the tsunami attack
1. Available communication equipment and priority
2. Securing crew
3. Canceling cargo handling
4. Possibility to secure navigation support
5. Influence of tsunami in mooring state

III Grasp the surrounding situation at the time of the tsunami attack
1. Damaged situation at a terminal
2. Information such as evacuation advice to ships
3. Port in port transport Information on control
4. Evacuation area

IV Judgment of tsunami correspondence behavior
1. Evacuation outside the port
2. Mooring enhancement
3. Remaining all members
4. Survey research on navigational safety measures at the time of major earthquake and large tsunami incidents (Japan Marine Accident Prevention Association)

III Navigation safety information
1. Information on sinks, drifting objects, etc.
2. Safety information on navigation during evacuation
3. Judgment after tsunami warning / warning notice
4. Emergency secured route information

VI Other events that may occur at the time of the tsunami attack
1. When your ship is damaged by an earthquake
2. When your ship is to be evacuated
3. Evacuation to the land area Action
4. Support for foreign captain

VII Other
1. Broadcast of tsunami evacuation manual to crew
2. Training assuming tsunami evacuation
National - Guidelines on harbor tsunami evacuation measures
September Heisei 25 (2013)
Ministry of Land, Infrastructure and Transport Harbor Bureau

1 About the guidelines on harbor tsunami evacuation measures...
   1.1 Purpose of guideline
   1.2 Formulation of guidelines Purpose
   1.3 Goal of the guideline
   1.4 Positioning of guidelines
   1.5 Review based on guidelines and plan to cooperate
   1.6 Major terms used in guidelines

2 Basic idea concerning formulation of tsunami evacuation countermeasures in ports
   2.1 Basic idea on tsunami countermeasures at ports
   2.2 The role of port administrator, country (regional development agency, etc.) related to
       the formulation of tsunami evacuation measures etc
   2.3 Ports that need to formulate tsunami evacuation countermeasures at ports
   2.4 Scope of Tsunami Evacuation Measures at Harbor
      2.4.1 Target person
      2.4.2 Target area
      2.4.3 Target tsunami
      2.4.4 Tsunami after the earthquake Target period for evacuation
      2.4.5 Countermeasure period for tsunami evacuation measures at ports

3 How to formulate tsunami evacuation countermeasures at ports
   3.1 Matters that need to be determined in tsunami evacuation measures at ports
   3.2 Arrangement of characteristics of harbors
   3.3 Establishment of Tsunami Inundation Assumption at Harbor
   3.4 Setting of evacuation target area
      3.4.1 Review and setting of areas subject to evacuation
      3.4.2 Examination and Extraction of Evacuation Difficult Areas
      3.4.3 Examination and setting of emergency evacuation sites, tsunami evacuation
            facilities, evacuation routes, etc.
   3.5 Securing the safety of those who need to engage in other tasks when a tsunami occurs
   3.6 Securing means of transmission of tsunami information etc.
   3.7 Criteria for evacuation judgment in port area
   3.8 Communicating the tsunami evacuation measures, enlightenment
   3.9 Evacuation drills
   3.10 Other points to keep in mind

4 Advancement of tsunami evacuation measures in harbors by further tsunami countermeasures
   4.1 Basic idea of further measures against tsunami evacuation
   4.2 Further case of tsunami countermeasures

5. Self assessment of tsunami evacuation measures (evaluation check list)
   Study system of guidelines on harbor tsunami evacuation
   Conclusion
### Response against Tsunami Checklist

(This sheet is not authorized as a guide by statute.)

#### Port and Ship Information
- **Port:**
- **Berthing direction:** Inbound / Outbound
- **Berth / Quay:**
- **Quay:** Seismic design / Non-seismic design
- **Ship name:**
- **Tonnage:**
- **Ship type:**
- **Crew:**

#### Basic Information
- **Safe water area:** From (°) to (°) Degree m
- **Water depth:** m
- **Location:**
  - **Latitude:**
  - **Longitude:**
  - **Distance from berth to safe water area:** nm
- **Time to arrive safe water area:** minutes
- **Place of evacuation area on land:** Handling support: Tug (Yes / No)

#### Contact Point
- **Agent:** Operating company:
- **Storehouse:** Harbor Master:
- **Line:** Japan Coast Guard:
- **Other:**

#### Confirm Tsunami Information in advance, if possible
- **The assumed maximum Tsunami height:** m
- **Time of arrival:**

#### Response against Tsunami (Basic Policy)

<table>
<thead>
<tr>
<th>Warning level</th>
<th>Tsunami height</th>
<th>On berthing</th>
<th>On anchoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Tsunami warning</td>
<td>More than 3m</td>
<td>Within ~minutes</td>
<td>More than ~minutes</td>
</tr>
<tr>
<td>Tsunami warning</td>
<td>1 ~ 3m</td>
<td>Within ~minutes</td>
<td>More than ~minutes</td>
</tr>
<tr>
<td>Tsunami advisory</td>
<td>Less than 3m</td>
<td>Within ~minutes</td>
<td>More than ~minutes</td>
</tr>
</tbody>
</table>

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### Basic Response List

(Ref in the as far as practicable)

#### Emergency departure
- **Confirm Tsunami occurrence indication from Port master, Harbor administrator, etc.**
- **Keep monitoring the latest information of Tsunami.** From TV, Radio or VHF.
- **Emergency departure**
  - **Interruption of cargo work**
  - **Crew readiness**
  - **Standby for departure (Engine and Thruster if provided)**
  - **Consider support Tug, handler and Mooring crew are necessary or not**
  - **Confirm store handling facilities (Crane, Loading Arm, Bellows Chute, etc...) available**
  - **Check the suitability of the departure route (Proximity of hazards and other vessels in way of departure route)**
  - **Unmooring or cutting lines**
  - **Give notice to the shore (relevant departments or the operating company), after departure**
- **Staying alongside**
  - **Check the ways to obtain the latest information.** (Preparing vessel on the advice or the indication from Harbor Master/ Harbor administrator, etc.)
  - **Check the safe area, the evacuation route for evacuation to the land**
- **Evacuation to the land**
  - **Crew readiness**
  - **Check the safe area, the evacuation route, the required time to evacuate etc...**
  - **Instruct crew to evacuate to land**
  - **Carry out the required work on board till Evacuation to the land**
  - **Disengaging the connections such as loading facilities between the ship and the land**

#### Attention in case of drifting

(Additional points)

- When the ship drifts from berth, the mooring may break, and cargo handling facilities, such as cranes etc, may collapsed, therefore crew shall evacuate to the safe area.
<table>
<thead>
<tr>
<th>Type of Tsunami Forecast</th>
<th>Available Time before tsunami arrival</th>
<th>Docked at pier</th>
<th>Countermeasures of ships</th>
<th>Navigating</th>
<th>Vessel (including fishing boat)</th>
<th>Small boat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tsunami Warning</td>
<td>Major 3m, 4m, 6m, 8m, Over 10m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>imminent</td>
<td>Vessels with hazardous material</td>
<td>Halt cargo handling and all other operation &amp; (B) (general rule)</td>
<td>(A)</td>
<td>(B) or (A) after getting a shore</td>
<td></td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>Standard (include a working ship)</td>
<td>Halt cargo handling &amp; (A)</td>
<td>(E)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>enough</td>
<td>Pleasure boat &amp; fishing boat</td>
<td>Halt cargo handling &amp; (B) or (A)</td>
<td>(D) or (A)</td>
<td>(E) or (B) ((A) in some case)</td>
<td></td>
</tr>
<tr>
<td>Tsunami 1m, 2m</td>
<td>imminent</td>
<td></td>
<td>Halt cargo handling and all other operation &amp; (B) (general rule)</td>
<td>(A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td></td>
<td>Halt cargo handling &amp; (A) or enforce mooring</td>
<td>(D) or (A)</td>
<td>(B) or (D) ((A) in some case)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>enough</td>
<td></td>
<td>Halt cargo handling &amp; (B) or (A) or enforce mooring</td>
<td>(D) in some cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tsunami Advisory</td>
<td>Tsunami Attention 0.5m</td>
<td></td>
<td>Halt cargo handling &amp; enforce mooring or (B)</td>
<td>(D) or (B)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks
- The enterprise shall prepare a manual in advance.
- If there is an evacuation or out of port for a boat, (B) is also recommended.
US NTHMP Outreach Products - Boaters

2-Level Response Guidance

Multiple-Level Response Guidance

Warning / Advisory

Scenario-specific

Tsunami Guideline Plan for Operators of Caribbean Ports

Hawai'i Boater's Hurricane and Tsunami Safety Manual
Thank You

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