



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



National Oceanic
and Atmospheric
Administration



International
Tsunami Information
Center



CTIC
Caribbean Tsunami
Information Centre
ctic.icc-unesco.org



Ministry of Foreign Affairs

Regional Training Workshop on Pacific Tsunami Warning
Center Enhanced Tsunami Products for ICG/CARIBE EWS
31 October – 02 November, 2017
Cartagena, Colombia

5.1 TWC and TER Guidance on how to use PTWC New Enhanced Products for National Warnings and Evacuation – Land and Marine Threats and Public Safety: Criteria Tables, Message Templates, Flow Charts and Timeline-driven SOPs

Christa von Hillebrandt-Andrade
NOAA-NWS Caribbean Tsunami Warning Program

Overview

- March 1, 2016 PTWC discontinued issuing Watch, Information Statements to CARIBE-EWS countries and began issuing Enhanced Products (Public and Limited Distribution).
- PTWC to issue Messages with Tsunami Forecasts (est wave heights or amplitudes)
- Sent by email to Country TWFPs and NTWCs
- TWFP/NTWC responsible for issuing Warning, Watch, Information Alert for its own country emergency

What are **SOPs**?

- Set of **written instructions** for routine/repetitive organization activities. Procedure followed in an emergency.
- Detail **work processes** conducted/followed within organization.
- Document way activities performed for **consistent conformance** to system requirements and organization's mission.

Based on US Environmental Protection Agency Manual

Why are SOPs important?

- **Foundation of effective, reliable warning system**
- **All warning systems require SOPs, but for tsunami, essential for rapid response (evaluation / warning / response)**
- **In an end-to-end system, communications links between stakeholders must be robust or warning chain will be broken**
- **SOPs developed, practiced and modified as necessary – a “living document”**

Country NTWC tsunami event Key SOPs:

- **Alert Criteria Table** (PTWC Enhanced Products User's Guide 135 and NTWC Guidance) gives guidance on alert threshold and Emergency Response actions
 - **Message templates** (App 2 of NTWC Guidance) facilitates quick standard responses. Checklists remind Duty Staff
 - **Communication Flow Chart** shows primary agencies / stakeholders of warning chain (Tsunami Service Providers => Natl / Local Warning / Emergency Authorities => Public)
 - **Timeline-driven SOPs help to plan** - describe Time, Who, What, How, and To whom.
- => Exercises** practice / improve TWC / TER SOPs

Alert Criteria Table

- Thresholds are used to assign Alert Levels (Warning, Advisory, Watch, Information)
- Alert Levels correspond to country's Forecast Maximum Coastal Wave Amplitude and/or earthquake magnitude
- Emergency Response Actions correspond to Alert Level



Simple Criteria Table

Countries may wish to further customize by assigning different thresholds for different source regions. Two situations:

- **NO QUANTITATIVE PTWC FORECAST.**
PTWC Information Statement or Threat Message within 10 min after M6.0/6.5+ earthquake.
- **QUANTITATIVE PTWC FORECAST PRODUCT**
PTWC Threat Message, ~30 min after large earthquake with tsunamigenic potential.
 - Warning / Watch Alerts (1.0 m threshold)
 - Warning / Advisory / Watch Alerts (0.3 / 1.0 m thresholds)

Alert Criteria Table

OT + 10 min: No PTWC message – No Threat

PTWC Product Type	Earthquake Parameters	Potential Tsunami Type	Are Possible Hazardous Tsunami Waves Indicated for Your Country or Area	Threatened Coast	Time left to Initial Wave Arrival (ETA)	NTWC Alert Level for Threatened Coast	Emergency Response Action
none	CARIBBEAN Magnitude less than 6.0	None	No	None	Not applicable	None	No action required
none	ATLANTIC Magnitude less than 6.5	None	No	None	Not applicable	None	No action required



Alert Criteria Table

OT + 10 min: No PTWC Forecast

PTWC Product Type	Earthquake Parameters	Potential Tsunami Type	Are Possible Hazardous Tsunami Waves Indicated for Your Country or Area	Threatened Coast	Time left to Initial Wave Arrival (ETA)	NTWC Alert Level for Threatened Coast	Emergency Response Action
Tsunami Information Statement	Magnitude of 6.0 / 6.5 * and greater , well inland, or ≥ 100 km depth	None or Very Minor	No	None	Not applicable	INFORMATION	No action required
	Magnitude of 6.0 / 6.5 * to 7.0 , undersea or very near the sea, and < 100 km depth	None or Very Minor	No	None	Not applicable	INFORMATION	No action required
Tsunami Threat Message	Magnitude of 7.1-7.5 , undersea or very near the sea, and < 100 km depth	Local Tsunami	Yes	< 300 km from earthquake	< 1 hr typical	WARNING	Evacuate threatened coast
			No	≥ 300 km from earthquake	Not given	INFORMATION	Monitor subsequent messages
	Magnitude of 7.6-7.8 , undersea or very near the sea, and < 100 km depth	Regional Tsunami	Yes	< 1000 km from earthquake	< 3 hrs typical	WARNING	Evacuate threatened coast
			No	≥ 1000 km from earthquake	Not given	INFORMATION	Monitor subsequent messages
	Magnitude of 7.9 and greater , undersea or very near the sea, and < 100 km depth	Basin-wide Tsunami	Yes	Potential for a basin-wide tsunami	< 3 hours	WARNING	Evacuate coast within 3 hours of ETA
			No		3 to 6 hours	WATCH	Standby, Prepare to evacuate
No			> 6 hours		INFORMATION	Monitor subsequent messages	

6.0 / 6.5 *: Caribbean / Atlantic Magnitude thresholds

Alert Criteria Table

OT + 30 min: Quantitative PTWC Forecast – 1 m

PTWC Product Type	Earthquake Parameters	Maximum Tsunami Wave Amplitude Indicated for Your Country or Area	Threatened Coast	Time left to Initial Wave Arrival	NTWC Alert Level for Threatened Coast	Emergency Response Action
Tsunami Threat Message	Magnitude of 7.1 or greater, undersea or very near the sea, and < 100 km depth	≥ 1 m	Sections of coast with forecast amplitudes ≥ 1 m	< 3 hrs	WARNING	Evacuate threatened coast
				3 to 6 hrs	WATCH	Standby, Prepare to evacuate
				> 6 hrs	INFORMATION	Monitor for subsequent forecasts
		< 1 m	None	INFORMATION	Monitor for subsequent forecasts	

Threatened coast information can be gotten from the public text message, coastal forecast amplitude maps or the KMZ file. If only the Public Text message is used, then the entire country should be placed in a Warning.

The 3-hour time criteria is based on the amount of time required for a country to safely complete a coastal evacuation. The 3-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required to safely evacuate all coasts of the State of Hawaii. Each country should consider their situation.

Alert Criteria Table

OT + 30 min: Quantitative PTWC Forecast – 0.3 / 1 m

PTWC Product Type	Earthquake Parameters	Maximum Tsunami Wave Amplitude Indicated for Your Country or Area	Threatened Coast	Time left to Initial Wave Arrival	NTWC Alert Level for Threatened Coast	Emergency Response Action
Tsunami Threat Message	Magnitude 7.1 or greater, undersea or very near the sea, and < 100 km depth	≥ 1 m	Sections of coast with forecast amplitudes ≥ 1 m	< 3 hrs	WARNING	Evacuate threatened coast
				3 to 6 hrs	WATCH	Standby, Prepare to evacuate
				> 6 hrs	INFORMATION	Monitor for subsequent forecasts
		0.3 to 1 m	Sections of coast with forecast amplitudes 0.3 to 1 m	< 3 hrs	ADVISORY	Evacuate beaches and harbors
				3-6 hrs	WATCH	Standby, Prepare to evacuate
				> 6 hrs	INFORMATION	Monitor for subsequent forecasts
		< 0.3 m	None		INFORMATION	Monitor for subsequent forecasts

NOTES:

- Threatened coast information from public text message, coastal forecast amplitude maps or the KMZ file. If only the Public Text message is used, then the entire country should be placed in a Warning.
- The 3-hour time criteria is based on the amount of time required for a country to safely complete a coastal evacuation. The 3-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required to safely evacuate all coasts of the State of Hawaii. Each country should consider their situation.

Message Products for Alert Levels

- **User's Guide TER**
- **Emphasize NTWC and NDMO/DMO are authorities**, not PTWC or other international
- **Create Templates for easy fill-in** (or automatically fill-in with incoming PTWC message). Basic text does not change. Duty Staff only need to fill in event information.
- **Include Review option:** If automated process or GUI used, need to make sure there are 'REVIEW BEFORE SEND' and 'MANUAL ENTRY' options

Message Products for Alert Levels - PTWC

- **Mimic EXISTING PTWC Text Bulletin (Warning, Watch, Information), or SIMPLE (status, action)**
- **Structure:** Header, EQ Info, Evaluation, Forecast (if applicable), Recommended Actions (depending on Threat Level), ETA, Potential Impacts, Tsunami Observations, Next Update and Additional Info
- **Customize for country**
 - Use Local Time
 - Replace PTWC with Country's NTWC
 - Retain only country locs (for threat, ETA). Delete other
 - Specify Local Authority for Public Safety Action (Evacuation), Contact info / how to obtain evac status
 - Specify update schedule

Flow Charts

Effective Way of Presenting SOPs

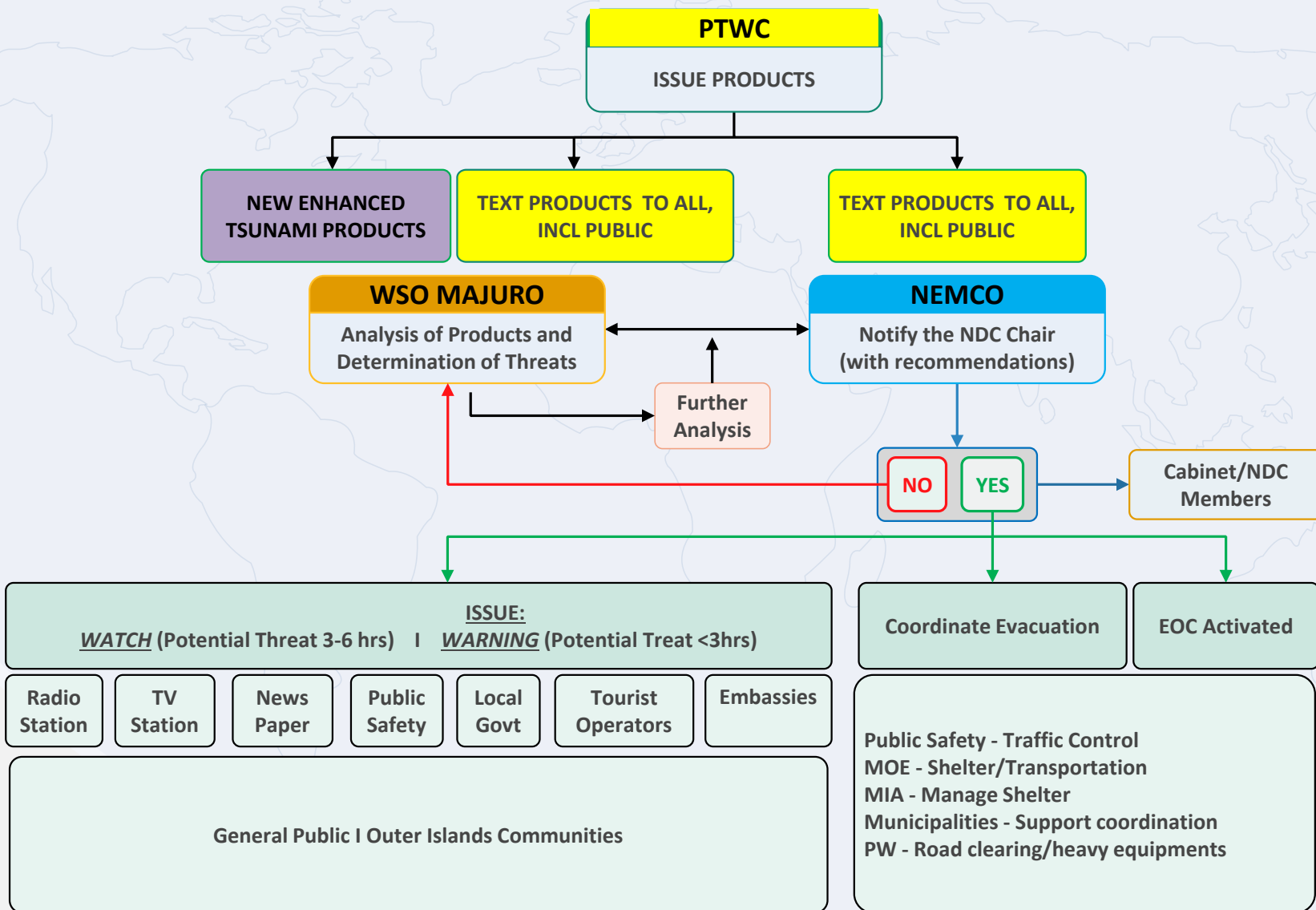
Flow Charts Indicate:

- **Steps to be followed**
- **Decision Tree**
- **Systems or subsystems involved**

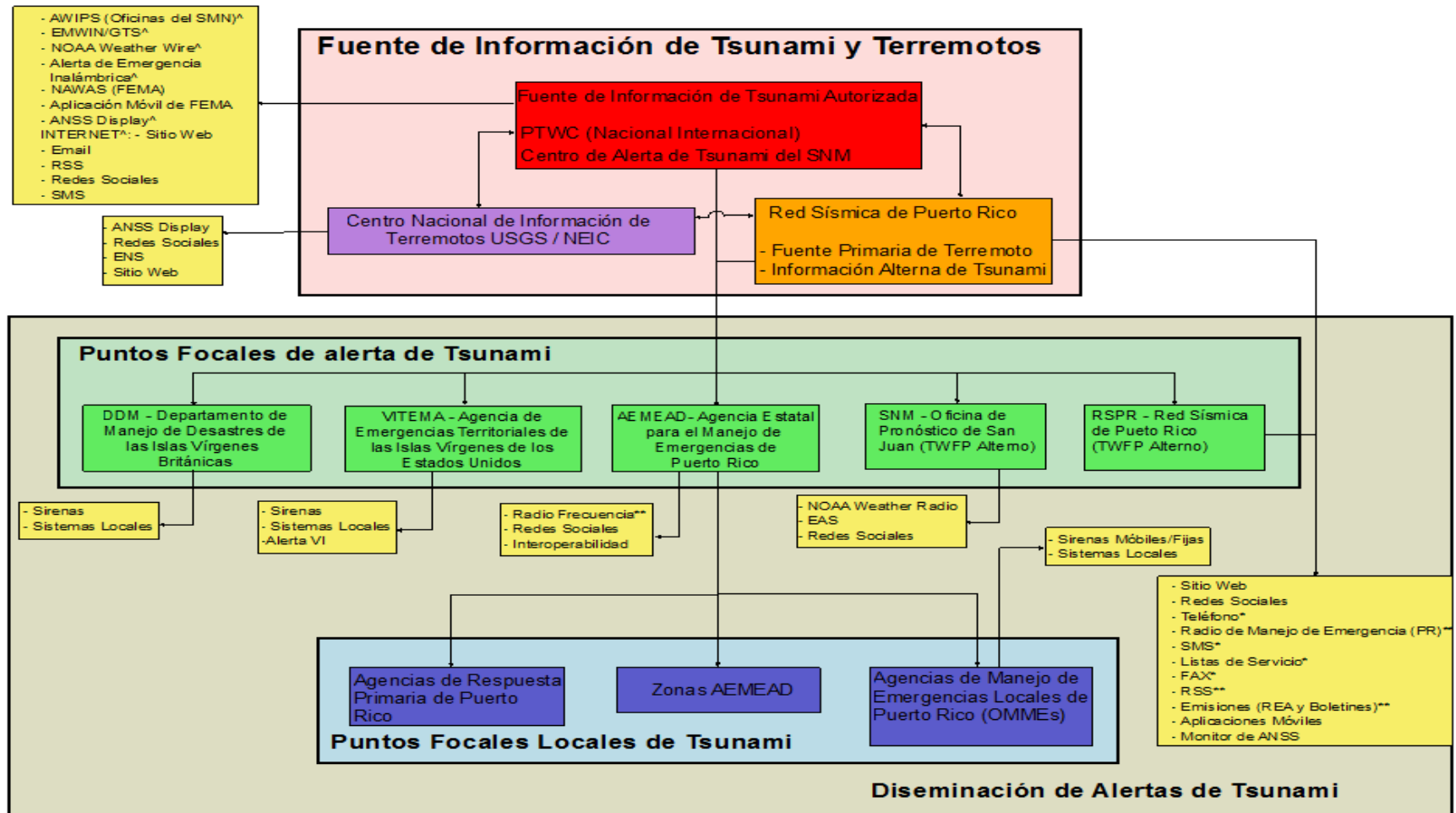
- **Flow Charts can be nested**
- **BUT, often not useful in real event
(cannot give answer when there is
uncertainty or data lacking)
(experience is most important)**



RMI TSUNAMI PRODUCTS COMMUNICATION FLOW CHART



PROTOCOLO DE COMUNICACIÓN DE TSUNAMI PARA PUERTO RICO E ISLAS VÍRGENES



* Por Suscripción

** Servicios Dedicados para Respuesta

[^] Mensajes Transmitidos Directamente de NWS/TWC

^o Incluye: - Departamento de Policía

- Departamento de Bomberos

- Servicios de Emergencias Médicas

- Guardia Nacional de Puerto Rico

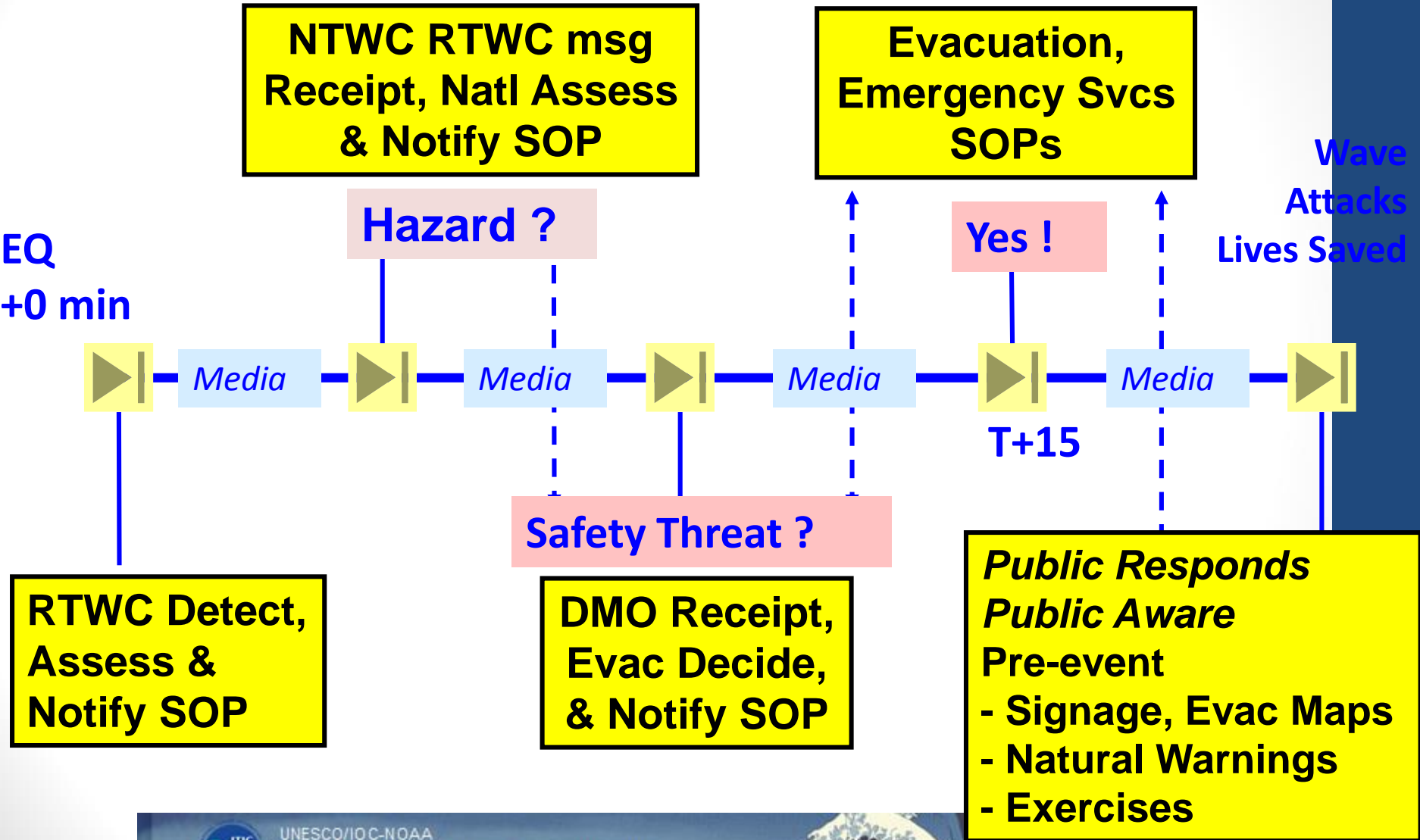
- Autoridad de Energía Eléctrica de Puerto Rico

Revisado Mayo/2017

Tsunami Warning SOPs are timeline-driven

TSUNAMI ACTION TIME LINE	TIME min after EQ	OBSERVATION	ACTION PTWC	ACTION NTWC	ACTION NDMO / Local Auth
	0	Strong ground shaking locally			
	1-5		Alarm triggers		
	5-15	Tsunami might come	Msg 1	Alarm CISN triggers	
	15-30		Msg 2 Forecast	WARNING	EVACUATION
	30-60	Tsunami confirmed	Msg 3 SL obs	Confirm Dangerous Tsunami	
	1-2+ hrs		Msg 4+ SL obs	Monitor and report SL obs	
	2-8+ hrs	Dangerous waves stop	Msg 5+ Last Msg	CANCEL WARNING	Search and Rescue
	3+ hrs	Safe to Return			ALL-CLEAR

End-to-End Warning SOP - Activities



Timeline-driven SOPs

- Planning for seamless, effective response. Manage expectations.
- Specify critical actions / decision points. What decision, and when it must occur
- **Add TIME to Communication Flow Chart**
- When, What, Who, How, To whom

EVENT	TIME (When)	ACTIVITY (What actions)	AUTHORITY (Who)	MEDIUM (How)	TO (Target audience)
EQ Occurs					
Assess Threat - Tsunami might come					
Evacuate					
Tsunami comes					
Safe to return / Declare "All Clear"					

EXAMPLE: TIMELINE-DRIVEN SOP

TSUNAMI SCENARIO: Distant Tsunami (8 hrs to arrive) TIMELINE-DRIVEN INFORMATION FLOW AND SOP for REPUBLIC OF MARSHALL ISLANDS Draft 0.2, April 2014, ITIC

Notes:

- PTWC will issue 1st Message in 5-15 min, 2nd Message in 30-60 min, and as new information received and/or regularly (nominally hourly). PTWC Text,, Graphical, Statistical Forecast Products only to PTWS TWFP (WSO Majuro) by email; PTWC Text Product is public and goes to many and posted on PTWC web site.
- WSO will issue TIS, Watch, Warning based on PTWC Messages and monitoring of earthquake and tsunami as it propagates across the Pacific. Updates as new information received and/or regularly

TIME (HRS AFTER EQ)	TIME (HRS BEFORE WAVE ARRIVAL)	TIME (WHEN)	EVENT	ACTIVITY - ACTION (WHAT IS DONE AND BY WHOM / INFO AVAILABLE)	AUTHORITY (WHO FROM)	MEDIUM (HOW)	TO (TARGET)	IMPACT
0	8	0000	EQ Occurs	WSS on Duty				
0.08	7.8	0005	PTWC EQ Observatory Message	WSS on Duty responds to Alarm / Email	PTWC	CISN (internet) Alarm / PTWC Email	All with CISN, or WSO	Unknown
0.12	7.75	0007	PTWC Message 1	PTWC Message – earthquake info WSO read and interpret message	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	
0.5	7.5	0030	PTWC Message 2	PTWC Message – W-phase Forecast. WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	3ft forecast in RMI
0.75	7.25	0045	TIS	WSO recommends to NDMO/NDC to issue TIS to inform that earthquake has occurred, and is monitoring	WSO issues?	Fax, Phone, ?	NDMO	
0-2	8-6	0000-0200	Large earthquake occurred	Read & Interpret PTWC Bulletins. WSO assess hazard (check for historical impact (online NGDC, offline TsuDig), monitor Tide Tool, contact WFO Guam/PTWC as needed). Inform & coordinate with NDMO.	WSO	Fax, Phone, ?	Natl Govt	Possible Tsunami at source. Waiting for confirmation

1-1.5	7-6.5	0100-0130	PTWC Message 3	PTWC Message - Forecast after DART readings, near-source tsunami observations WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	4ft updated forecast in RMI
2	6	0200	Watch	WSO recommends to NDMO/NDC to issue Watch. Get Ready / Prepare, Do NOT Evacuate at this time. Inform Public	WSO issues?	Fax, Phone, ?	NDMO	
2.25	5.75	0215	Activate EOC	NDMO Watch Staff notify Cabinet / NDC / Stakeholder Agencies, etc to report to EOC	NDMO	Phone, ?	Cabinet, NDC, Stakeholders Agencies,	
2-5	6-3	0200-0500	Tsunami confirmed near source	Read & Interpret PTWC Messages. Monitor tsunami progress across Pacific. Consult with WFO Guam, PTWC or ITIC if needed. Update expected RMI threat. Inform & coordinate with EOC	WSO	TideTool, Pre-computed scenarios, Phone, Radio, etc		May be dangerous to RMI
2.5	5.5	0230	PTWC Message 4	PTWC Message – observations WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	
3	5	0300	Watch	WSO recommends to NDMO/NDC to issue Watch, hourly update. Report obs as tsunami propagates across Pacific	WSO issues?	Fax, Phone, ?	NDMO	
3.5	4.5	0330	PTWC Message 5	PTWC Message – observations WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	
4	4	0400	Watch	WSO recommends to NDMO/NDC to issue Watch, hourly update. Report obs as tsunami propagates across Pacific	WSO issues/	Fax, Phone, ?	NDMO	
4.5	5.5	0430	PTWC Message 5	PTWC Message – observations WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	
5	3	0500	Warning	WSO recommends to NDMO/NDC to issue Warning	WSO issues?	Fax, Phone, ?	NDMO	4ft flooding expected



5.25	2.75	0515	Evacuate	NDMO issues Evacuation	Natl EOC	Radio, TV, etc	Public	
				Various EM activities, such as Roadblocks, Vulnerable Communities (Outer Islands)/ Special Needs Population / Schools evacuation notification and evacuation, Critical Infrastructure notification and response, Ports and Harbors, Airport, etc				
6, 7	2, 1	0600, 0700	Warning	WSO recommends to NDMO/NDC to continue Warning, provide observations	WSO issues	Fax, Phone, ?	NDMO, State/Local EMO	
5-8	3-0	0500-0800	Tsunami propagating across Pacific	Read and Interpret PTWC Messages. Monitor tsunami progress across Pacific. Update expected RMI threat. Inform and coordinate with EOC	WSO		Natl Govt	Dangerous tsunami expected
8	0	0800	Warning, Tsunami arrives	WSO reports tsunami observations in RMI				First wave 6ft high
8-13?	0 to -5?	0800 and later	Dangerous tsunami waves continue to arrive	WSO monitors local sea level gauges to determine when dangerous tsunami waves have stopped arriving. Inform and coordinate with EOC. Make and receive calls giving observations/impact/damage	WSO			Later arriving waves may be > 6ft
?	?	?	Warning Cancellation	Consult with WFO Guam, PTWC or ITIC if needed. WSO recommends to NDMO/NDC to issue Warning Cancellation, or downgrade to Advisory. Waves no longer dangerous. Determine if people should stay out of the water for an additional period (Advisory)	WSO		State / Local / Natl Gove	Waves small (<1 ft)
?	?	?	Search and Rescue	First Responders begin Search and Rescue, if necessary.	State DCO			
?	-12 ?	2000	Safe to return	NDMO / State / Local Authorities issue All-Clear for populations to return to evacuated zones				

Final Guidance

- ❑ Remember Goal: Early warning to save lives
- ❑ **Successful warning** must be in **time, understood, and actionable** (e.g., Warning => Evacuate)
- ❑ For local threat (< 30-45 min), **Education** priority.
People must: 1. Act on Natural Warnings, 2. Self-Evacuate - do not wait for NTWC warning
- ❑ NTWC issue **Alert using pre-determined criteria**. Duty Staff know what to look for in PTWC products
- ❑ NTWC can decide **Alert Level using only Public Text** (e.g., map forecast height to Warning). NTWC does NOT need to use all products (these add value, further detail).

SUMMARY - MOVING FORWARD

- Develop SOPs
- Use SOPs (Real Event or Exercise)
- Did they work?

If not, revise them IMMEDIATELY

- KEEP IT CLEAR, CONCISE, SIMPLE
- FOLLOW YOUR PROCEDURES
- It becomes your basis for action, and is defensible post-event



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



National Oceanic
and Atmospheric
Administration



International
Tsunami Information
Center



CTIC
Caribbean Tsunami
Information Centre
ctic.ic-unesco.org



Ministry of Foreign Affairs

Regional Training Workshop on Pacific Tsunami Warning
Center Enhanced Tsunami Products for ICG/CARIBE EWS
31 October – 02 November, 2017
Cartagena, Colombia

Thank You

Christa von Hillebrandt-Andrade
NOAA-NWS Caribbean Tsunami Warning Program