1. **Hazard mapping and Earthquake Detection**

Natural Resources Division of the Ministry of Lands, Survey and Natural Resources continues to monitor seismic activities and relay to Meteorological Office for dissemination if there is a tsunami alert around the Kingdom.

There are 5 seismic stations including Tongatapu, Ha’apai, Vava’u, Niuatoputapu and Niuafo’ou. Seismic data transmitted to Central Hub using satellite except one station is transmitted by radio wave transmission. Currently there are only 3 stations are operating and 2 are down due to technical problem. The Geo-hazard Unit of the NRD is working hard to revive those stations.

There are other sources that are using for seismic detection apart from our local network are, CISN, USGS, Seiscomp3. These sources are all rely on internet. GSU also has access to ORSNET data for quick earthquake analysis.

The Geo-hazard Unit is operating 24/7 with 6 staff are shift and 2 on call.

Pacific Resilience Project (PREP) will fund to upgrade our seismic stations and install about 5 more volcanic monitoring stations in volcanic islands around the Kingdom. This can help us to improve the seismic monitoring and faster analysis of seismic events.

Staff were trained (under PREP) in Vanuatu for installation seismic station as Tonga has plans trial and use same setup as the Vanuatu system for volcanic monitoring system.

There are challenges that the Geo-hazard Unit facing:

a. Lack of professional staff in the field of seismology
b. Limited staff numbers to cover 24/7 operations
c. Resources and expertise to carryout seismic station maintenance
d. GIS and mapping training

Limited mapping of tsunami inundation areas and evacuation planning mapping is done by the GIS.

2. **Warnings and Dissemination**

the First Pacific Meeting of Ministers of Meteorological Services (PIMMS) in Nuku’alofa, Tonga in July 2015 recognizes that the Pacific region is highly prone to tsunami with several countries having recently experienced locally generated tsunamis, requiring rapid detection and prompt dissemination of tsunami warnings to coastal communities and therefore the need to strengthen Early Warning Systems for this hazard;
Tonga relies heavily on internet based communications for the receipt of earthquake and tsunami advisory products and that there is a need to have a backup satellite feed. 3 Meteorologists have been trained to support the Forecasting and Tsunami warning Centers. A total of 4 Meteorologists and 5 Meteorological Technicians Support the Centre. 2 further meteorologists are due to join the team at the end of 2017.

The biggest gaps in the Warning Centre is the competency of warning staff, access to near real-time earthquake data and expert review of the tsunami warning standard operating procedures.

3. **Tsunami Disaster response**

(a) Tonga participated in PACWAVE17 on 15 February 2017 taking the 9M scenario on the Tonga trench as it scenario and using its own situation injections. The exercise was a desktop exercise with the 15 first responder agencies with the objectives to test out the SOPs for first responders with a functional component to test the tsunami sirens in place. The exercise controller was the Director of Meteorology (‘Ofa Fa’anunu). Outlined below is the results of the hot-debrief conducted

<table>
<thead>
<tr>
<th>Agency/Department /Organization</th>
<th>Comments/Remarks</th>
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<tbody>
<tr>
<td><strong>Tonga Meteorological Services</strong></td>
<td>(1) Response time to a major “local event” is very short. Verbal warning direct on radio should be priority over sending the standard warning template.</td>
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<td>(2) Need to reduce the urgent warning template to fewer words and in a very short clear format</td>
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<td>(3) Live talking and interview may be the most appropriate way of communicating immediately after the earthquake and the continued activation of tsunami sirens</td>
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<td>(4) Need a more effective communication strategy for the establishment and utilization of VHF/HF radio networks to all line ministry and agencies.</td>
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<td>(5) Needs more awareness training for public to act when and earthquake occurs and not wait for warnings.</td>
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<td>(6) Need to conduct more regular drills for local earthquakes and tsunami</td>
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</tbody>
</table>
| National Emergency Management Office | (1) Need to enforce awareness programs through joint efforts with NGO’s  
(2) SOP in regards to local events does not clearly reflect the time of declaring state of emergency  
(3) Need to further look at security issues of the NEMO office if it is to be an evacuation point  
(4) Need to confirm who evacuates the King, Prime Minister, Heads of Government and Diplomatic Corp. |
|--------------------------------------|------------------------------------------------------------------------------------------------------|
| His Majesties Armed Forces           | (1) The need for Tsunami sirens to be activated and functional at all times  
(2) The importance of communication channels between key law and order forces such as the HMAF, Tonga Police, Tonga Search and Rescue and NEMO office to be maintained in a more effective way.  
(3) The use of new technology initiatives such as drones to monitor and update status of situation is recommended to better manage the situation in times like these.  
(4) The need to reinforce and emphasize clear tsunami evacuation routes/points.  
(5) Continue public awareness programs to be done regularly on this issue. |
| Tonga Fire Services                  | (1) Recommend shifting of VHF/HF repeaters (VHF/HF) to towers on safe ground ensure continued communication during times of crisis.  
(2) Need to re-inforce the communication between 1st responder agencies such that a dedicated radio frequency should be established for all line agencies for better communication and coordination  
(3) The need for the continuous and regular conducting of public awareness programs  
(4) Need to confirm timing of declaring of state of emergency based on a major local earthquake event for Tonga |
| Ministry of Internal Affairs         | (1) Need for more effective institutional arrangements for response  
(2) Reinforce effective communications  
(3) Need to develop tsunami SOPs for MIA |
<table>
<thead>
<tr>
<th>Organization</th>
<th>Recommendations</th>
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<tr>
<td>Digicel</td>
<td>(1) Is to ensure and establish a more robust secondary operation center at Mata-ki-eua.</td>
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<td>(2) They are confident that Digicel mobiles and networks will still be running in this event.</td>
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<td>(3) They need the official urgent tsunami advisory template for their dissemination and broadcasting when the event occurs.</td>
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<td></td>
<td>(4) Proposed the utilization of their Digicel towers as secondary repeater posts during this event to ensure continuous VHF/HF radio network communications in times of operations</td>
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<td>(5) Pre-recorded messages to be generated and given to Digicel for immediate broadcast when local earthquake of this magnitude occurs.</td>
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<tr>
<td>Tonga Red Cross Society</td>
<td>(1) The need and importance to continue the awareness programs to the people and what to be done before, during and after these events.</td>
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<tr>
<td>FM 87.5</td>
<td>(1) Based on such a major earthquake SOP and preparations will be amended for technical equipment and preposition standby generator to ensure continuity of being on air.</td>
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<tr>
<td>Geological Service Unit</td>
<td>(1) The need for tsunami sirens to be more louder, clear and longer sounding intervals/periods and to also convey urgent tsunami messages via these tsunami sirens</td>
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<td>(2) Continuous or regular drills being carried by the ministry of education in regards to evacuation plans</td>
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<td>(3) The need for tsunami sirens to be played via radio and other media outlets</td>
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<td>(4) The need for this exercise to move to the next phase into a full-scale functional exercise</td>
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<tr>
<td>Tonga Search &amp; Rescue</td>
<td>(1) The need to strategically move operational center into a safer location from its present location</td>
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<td>(2) Reinforce better effective coordination between key 1st responding agencies</td>
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<td>(3) Awareness programs to be more engaging and pro-active</td>
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<td>(4) The need for road networks to be more upgraded for easier access to safe zones during the time of event</td>
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<td>(5) The need for government to help initiate these activities and plans</td>
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</table>
Ministry of Education

1. The need for back up radios in all schools in Tonga and to revise SOP and emergency plans
2. To involve the Ministry of education in all our awareness programs and for these awareness programs to be all year round but seasonal
3. To implement a more coordinated plan to be supported by all 1st responder agencies
4. Special consideration needed for kindergarten and pre-schools is a major obstacle in this situation given their very young age and increasing numbers in the Nukualofa CBD area which is already a vulnerable area to tsunami events and other social inter-related issues
5. Recommends that the evacuation procedures is to be effectively taken up by the school principals and teacher immediately.

(b) **Cluster System** – Tonga has adopted the cluster system since Tropical Cyclone “Ian” in 2014 and various stakeholders work within this framework in all phases of the disaster management cycle. It has been a real success with many stakeholders participating. The approach is a multi-hazard one and tsunami is capture within. The National Emergency Management Office Coordinates and lead agencies lead the different clusters in implementing their respective work plans.

(c) **Tsunami Ready** – The NEMO, Met Office, Red Cross and SPREP successfully trialed the tsunami ready checklist on the remote island of Mounga’one in 2015 and 2016. Plans are in place now to roll it out in other communities.

(d) **Awareness activities** – Most tsunami awareness activities were done through radio and TV through coordination with the NEMO. Evacuation planning, school visits and drills were also carried out for schools in the tsunami inundation zone (15 schools) during the intersessional period through funding from the European Union.

4. **Capacity development and new initiatives**

Under the Pacific Resilience Project (PREP) funded by the World Bank, Tonga plans to upgrade it seismic network as well as establish a new volcano monitoring network. Under that same project a multi-hazard early warning system will be established as well as improved inter island communications and office infrastructure. (USD$11M). Through the Climate Resilience Sector Project (CRSP) funded by the Asia Development Bank Tonga also plans to upgrade its sea level stations (USD$700K). JICA is also assisting Tonga establish a robust alerting system, activation for sirens and upgrade to AM transmission station (USD$13M).