TSUNAMI READY FOR CRITICAL INFRASTRUCTURE

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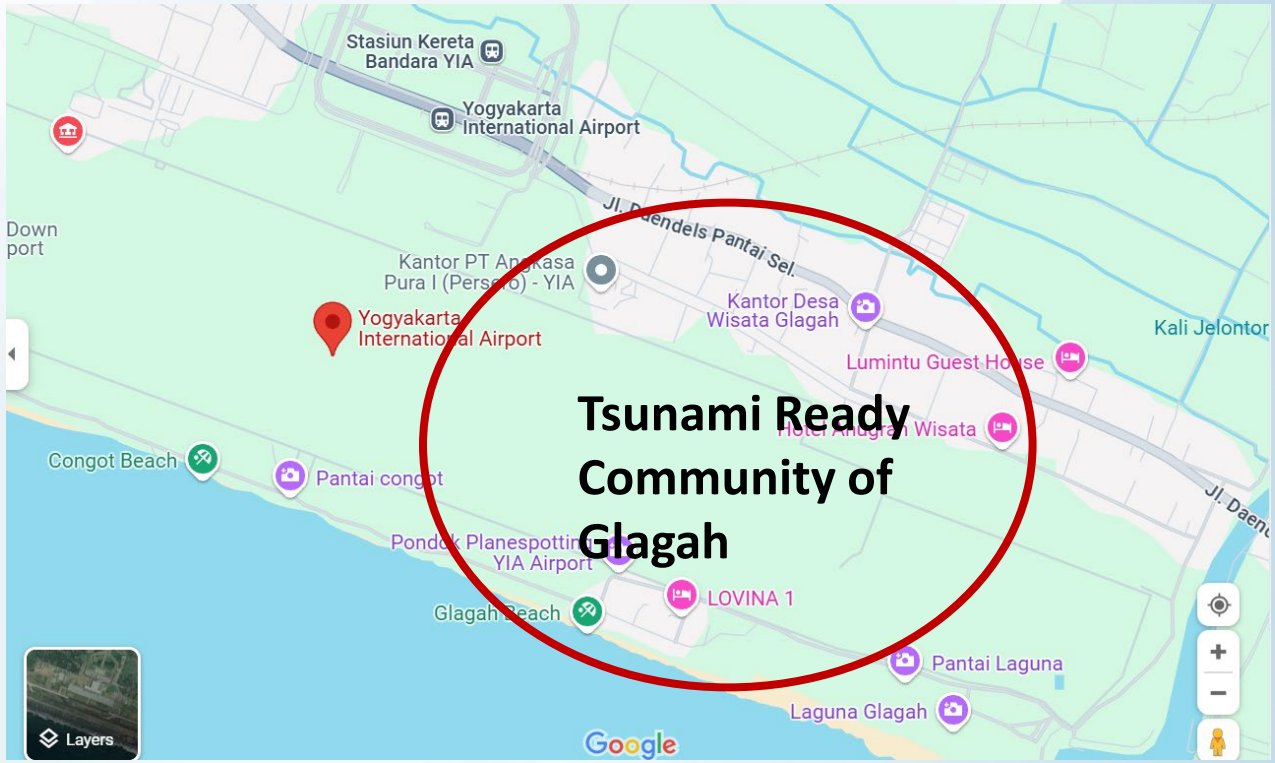
Chair of WG 1 and Chair of WG3

BACKGROUND

- Critical Infrastructure is part of the community
- Critical Infrastructure (ex: Port) is one of the critical facilities for public with a very busy and rapid activities for 24 hours in 7 days operation
- Critical infrastructure has a strategic function in ensuring the availability of logistics transportation in during the emergency period of disaster
- The ability to continue business activities of the critical infrastructure will accelerate the rehabilitation process after disaster.
- Requirement of infrastructure's resistance design criteria to earthquake and Indonesia

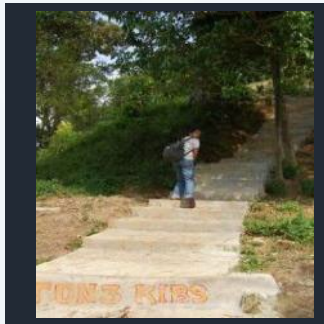


Critical Infrastructure is part of the Tsunami Ready Village

Technical Guidelines for Vertical Tsunami Evacuation Shelter - TES

Source: Harkunti et al 2015

Decision for Type of TVES

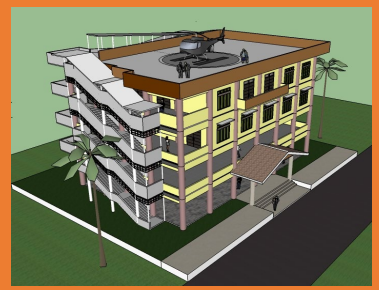


If you have existing Hill with sufficient height

If you have existing building with sufficient height and its strength toward seismic and tsunami load as requested in Structural Design Criteria

- If ETE > (ETA – TEW)
- If No Natural Hill and No Existing Buiding complied with design criteria

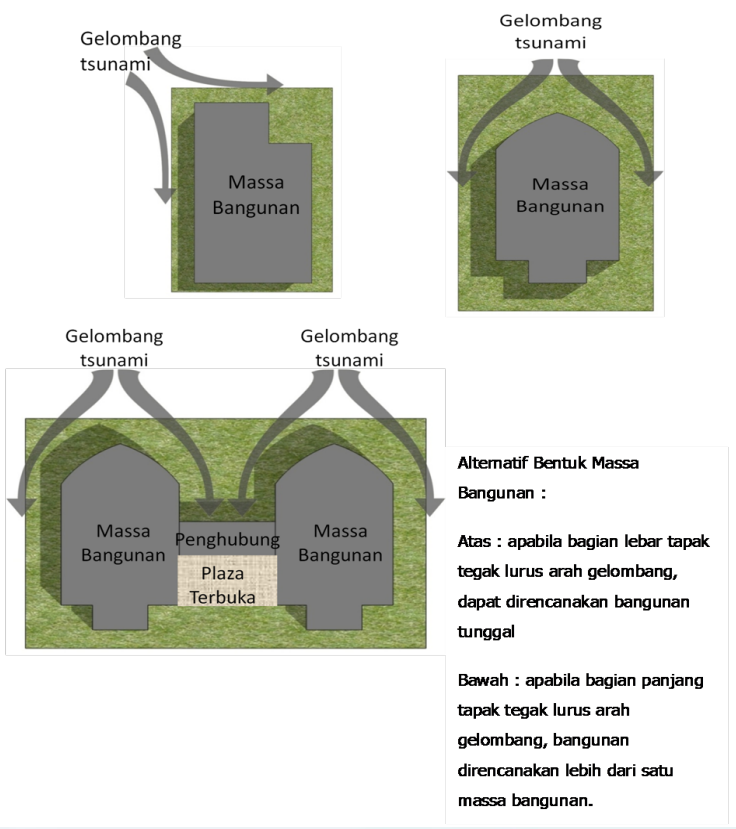
1. Single Purpose TVES



2. Multi Purpose TVES

Aspects of Building Mass Composition

- Bagian bangunan yang menghadap arah gelombang harus berbentuk *aerodinamis*.
- Lantai 1 bangunan sebaiknya terbuka → memungkinkan gelombang tsunami mengalir dan menghindarkan bangunan dari hempasan gelombang
- Alternatif lain adalah halaman dan teras bangunan ditinggikan → di atas level rendaman tsunami.

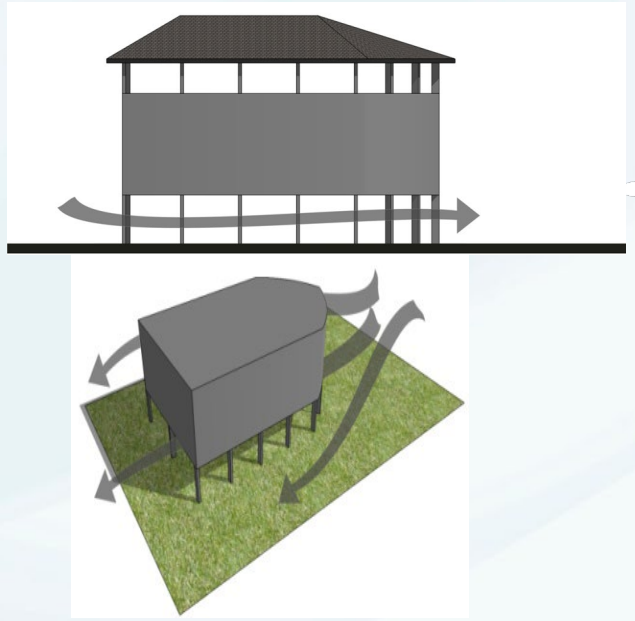


Alternatif Bentuk Massa Bangunan :

Atas : apabila bagian lebar tapak tegak lurus arah gelombang, dapat direncanakan bangunan tunggal

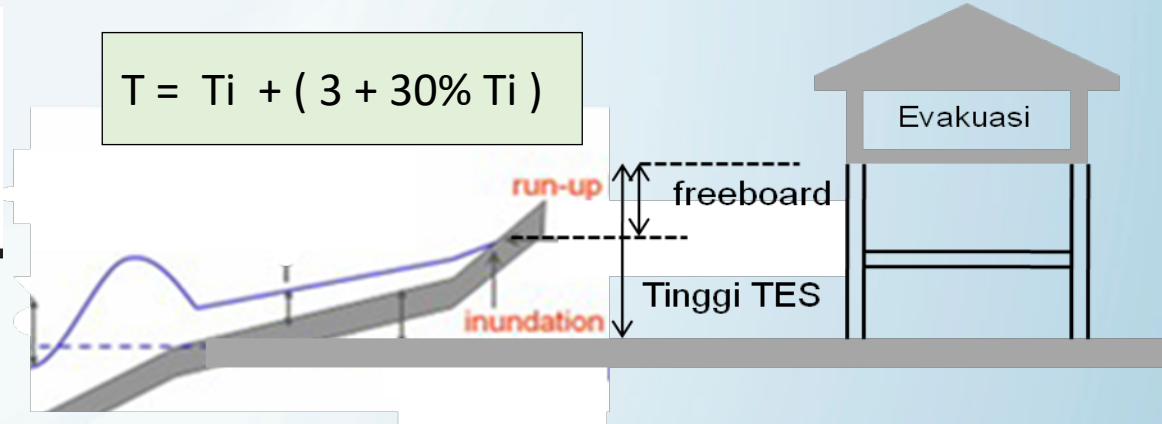
Bawah : apabila bagian panjang tapak tegak lurus arah gelombang, bangunan direncanakan lebih dari satu massa bangunan.

Alternatif bentuk massa bangunan



$$T = Ti + Freeboard$$

$$T = Ti + (3 + 30\% Ti)$$



T = TVES height from earth surface (m)

Ti = *inundation height* (m)

Freeboard = 3 m + 30%Ti

Estimated Minimum Height for TVES from earth surface

Structural Design Criteria: Design Load

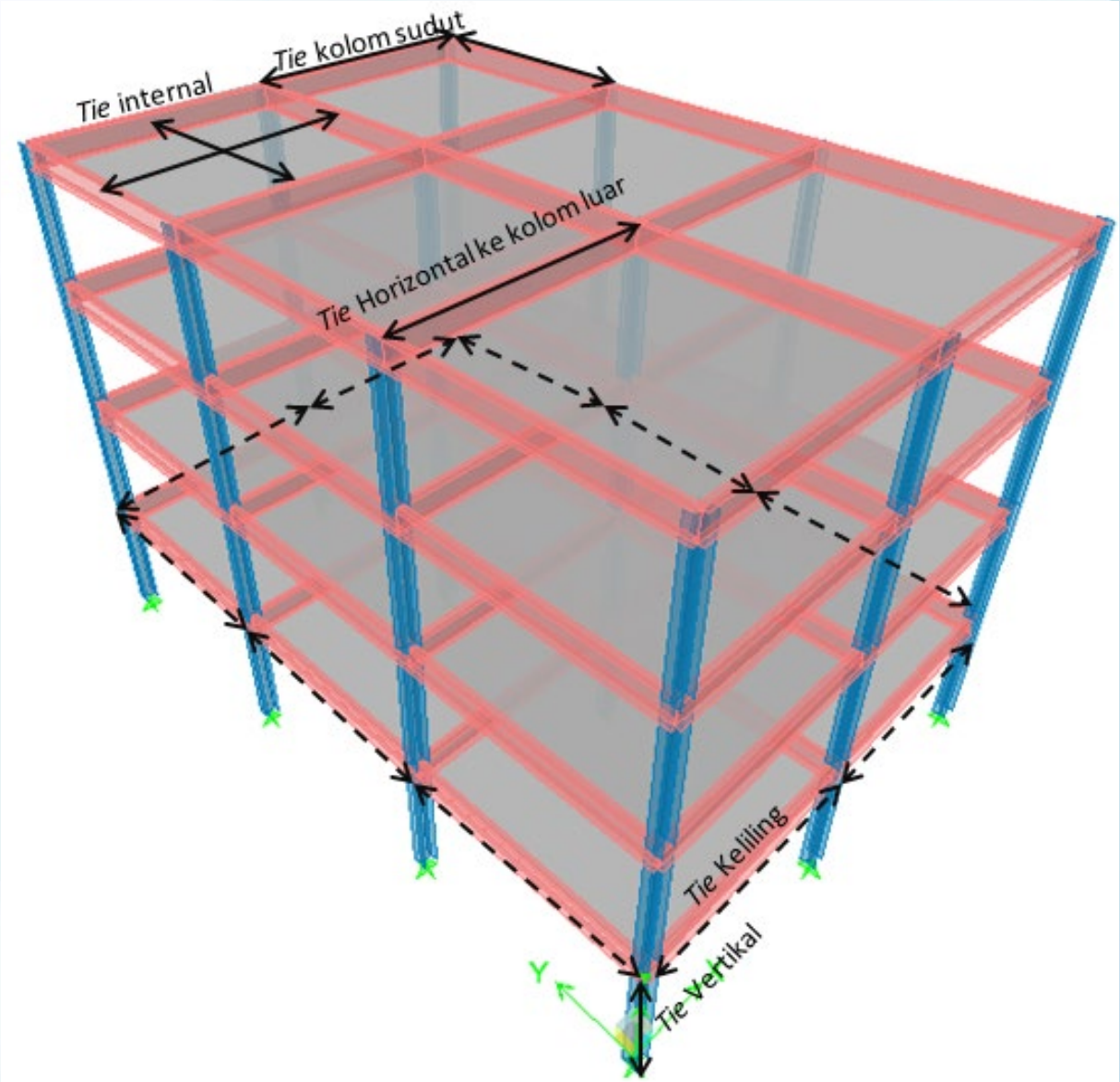
1. Gravitation Load
2. Seismic Load
3. Wind Load
4. Tsunami Load

Source: Iswandi Imran, et al 2015

Structural and Ductility Aspect

- **STRUKTUR**
  - Bangunan TES secara minimum harus memenuhi persyaratan SNI-0301726-2002 - Tata Cara Perhitungan Struktur Beton untuk Bangunan Gedung dan peraturan setelahnya:
    - Bangunan TES harus memiliki tingkat keamanan terhadap gempa dan tsunami
    - kuat menahan hempasan gelombang tsunami, gaya apung, gaya hidrostatis, gaya hidrodinamis, pengaruh pengikisan, dan pengaruh tumbukan

- 2. Kolom berbentuk lingkaran dapat menghasilkan gaya *drag* yang lebih kecil dibandingkan kolom yang berbentuk persegi atau persegi panjang.



PILOTING TSUNAMI READY FOR CRITICAL INFRASTRUCTURE

Ngurah Rai Airport

YIA Airport

Minangkabau Airport

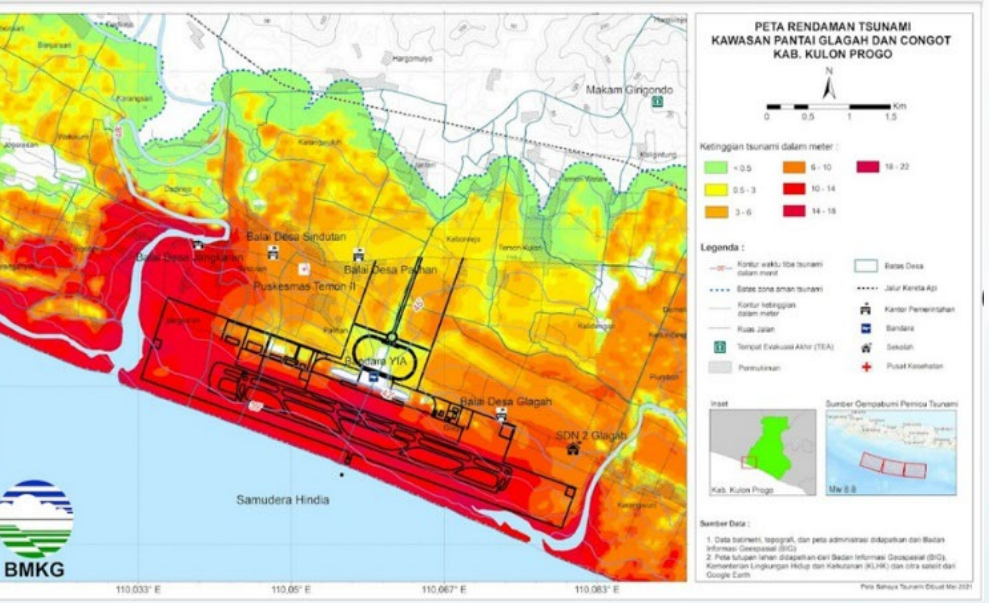
TR for Port of Benoa Bali

TR for Cilegon Industrial Zone

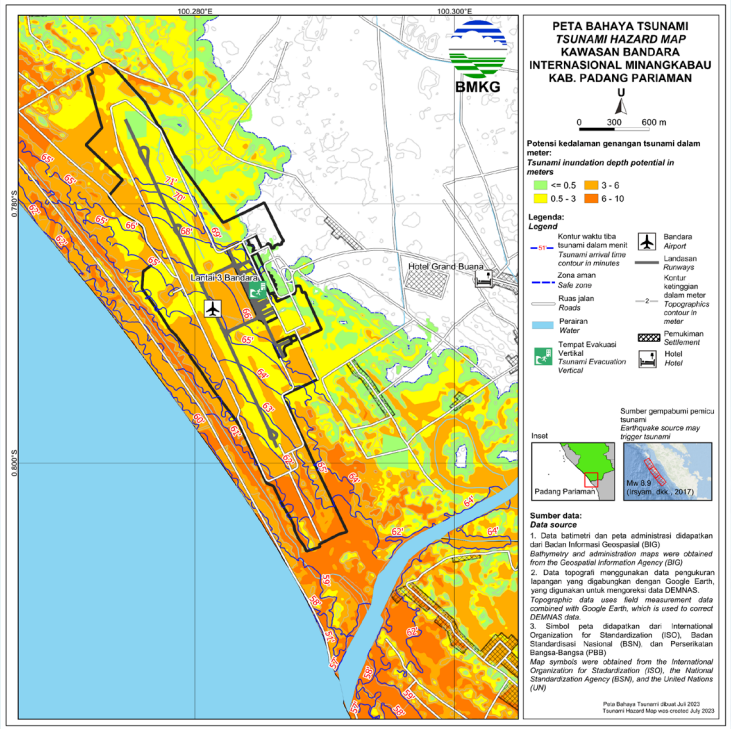
Critical Infrastructure for Tsunami Ready based on the 12 indicators of Tsunami Ready

	TSUNAMI READY INDICATORS
I	**ASSESSMENT (ASSESS)**
1	**ASSESS-1**. Tsunami hazard zones are mapped and designated.
2	**ASSESS-2**. The number of people at risk in the tsunami hazard zone is estimated.
3	**ASSESS-3**. Economic, infrastructural, political, and social resources are identified.
II	**PREPAREDNESS (PREP)**
4	**PREP-1**. Easily understood tsunami evacuation maps are approved.
5	**PREP-2**. Tsunami information including signage is publicly displayed.
6	**PREP-3**. Outreach and public awareness and education resources are available and distributed.
7	**PREP-4**. Outreach or educational activities are held at least 3 times a year.
8	**PREP-5**: A community tsunami exercise is conducted at least every two years.
III	**RESPONSE (RESP)**
9	**RESP-1**. A community tsunami emergency response plan is approved.
10	**RESP-2**. The capacity to manage emergency response operations during a tsunami is in place.
11	**RESP-3**. Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place.
12	**RESP-4**. Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place.

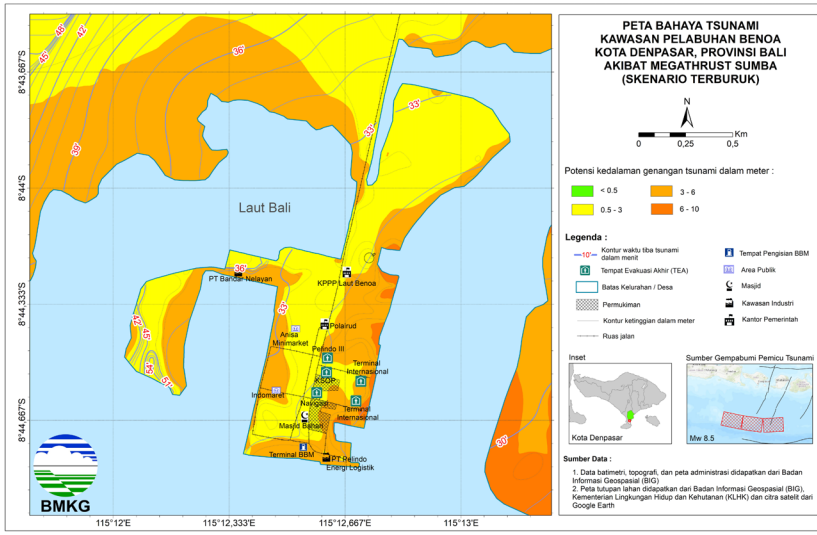
DEVELOPING TSUNAMI HAZARD MAP FOR CRITICAL INFRASTRUCTURE



Tsunami Hazard Map for YIA



Tsunami Hazard Map for YIA



Tsunami Hazard Map for Benoa Port

BMKG developed the Tsunami Hazard Map for the Critical Infrastructure as the assessment indicator of Tsunami Ready

TSUNAMI EDUCATION ACTIVITIES FOR CRITICAL INFRASTRUCTURE

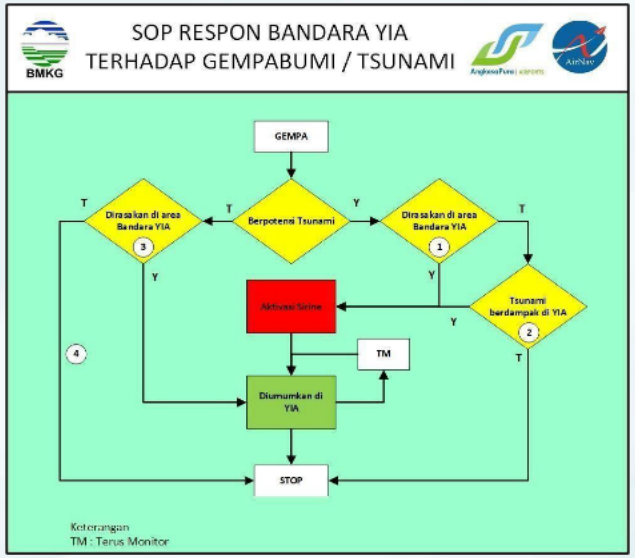
- BMKG Conducted the thematic Earthquake Field School for the Airport, Port, and Industrial Zone
- The participant learned:
  - Earthquake and Tsunami Potential
  - How to response the earthquake and evacuation process
  - Tsunami Warning Information

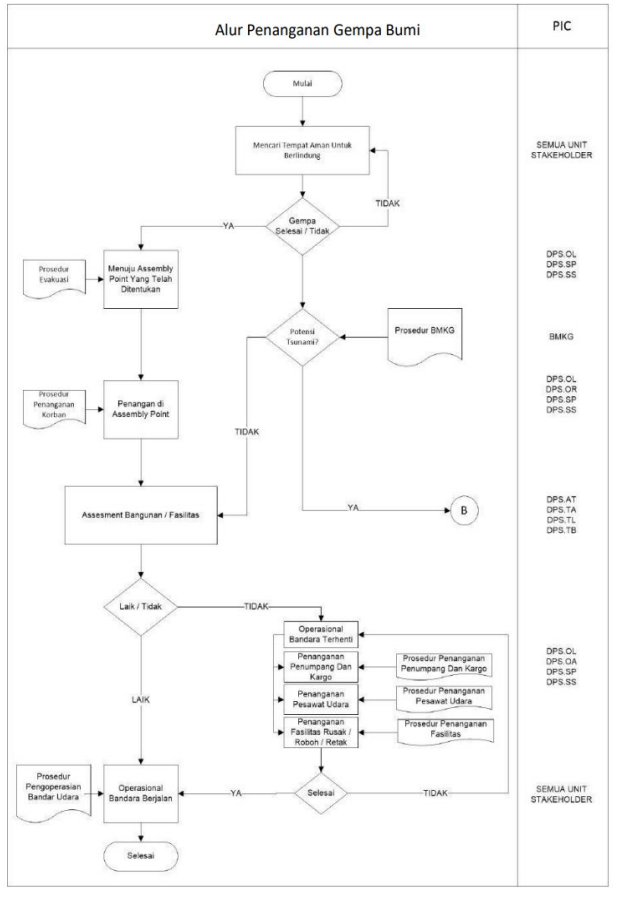
Education Activity for Cilegon Industrial Zone

Earthquake and Tsunami Field School for YIA

FORMULATING SOP OF EARTHQUAKE AND TSUNAMI

- Critical Infrastructure need to be completed with a robust early warning including clear SOP to response the warning
- BMKG gave advocacy to formulate the SOP of the Critical Infrastructure
- The Tsunami Warning is involved to the SOP
- FGDs were conducted to formulate the SOP



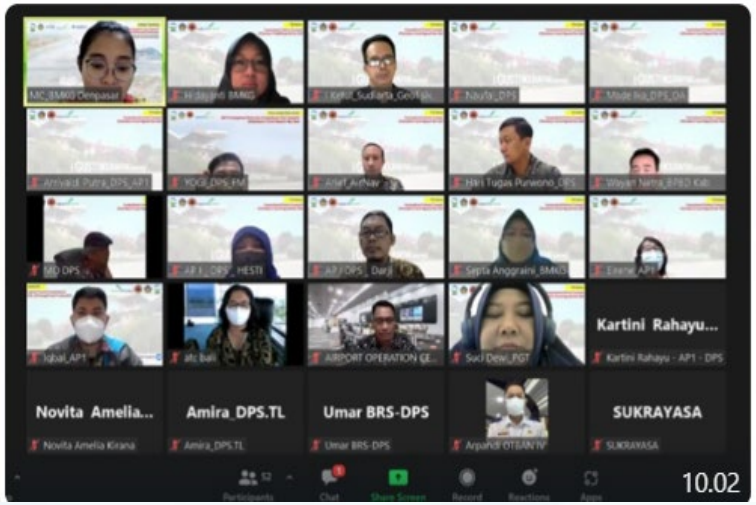


Port Tsunami Ready Respon SOP, Involving the Early Warning Procedure

EARTHQUAKE AND TSUNAMI SIMULATION FOR THE CRITICAL INFRASTRUCTURE

Table Top Exercise for the Ngurah Rai Airport

IOWave Exercise of the YIA



Online Table Top Exercise
for the Ngurah Rai Airport

BMKG facilitating and giving advocacy to conduct the exercise for Airport, Port, and industrial zone

The exercise could be in the form of Evacuation Drill, Table Top Exercise and Indian Ocean Wave

The YIA conducted the evacuation drill and participated by the communities surrounding

PROVIDING ACCESS TO THE TSUNAMI EARLY WARNING

- BMKG provided Warning Receiver System for the Critical Infrastructure to access the Tsunami Warning
- The AOCH, and the officer of the AOCC were given the education of tsunami warning

Robust Access for Early Warning in the Port of Cilegon

Access for Early Warning at the Command Center of the YIA

Access for Early Warning at the Airport Operation Control Center of the Ngurah Rai Airport

Endorse The Critical Infrastructure to Accelerate the Achievement of EW4All and 100% Tsunami Ready

- Critical Infrastructure has a strong resource and capacity to support the development of tsunami ready.
- Critical Infrastructure is part of the community that also has responsibility to develop the preparedness capacity for tsunami ready

- Fisherman Community in the Cilegon Industrial Estate has facilitated the Siren, Assembly Point, and Evacuation Sign by KSP Industrial Company

Evacuation shelter for tsunami in the YIA that also used by the community surrounding as the evacuation place

REMARKS

1. As a part of the community Critical Infrastructure should be one of the ecosystem that has a capacity of Tsunami Awareness, Preparedness and Response
2. 12 indicators of Tsunami Ready could be starting point to establish the Tsunami Ready for Critical Infrastructure
3. Tsunami Ready Community for the Critical Infrastructure to make sure the people who work and utilize the infrastructure Ready for Tsunami
4. Tsunami Ready for Critical Infrastructure could help community surrounding to accelerate the community capacities on tsunami ready
5. Indonesia will continue the good efforts on implementing tsunami Ready for critical infrastructure (airport, port, and industrial zone)
6. Propose the UNESCO-IOC to be able to recognize the Tsunami Ready for Critical Infrastructure

THANK YOU