



HAZARD-SPECIFIC ANNEX A TROPICAL CYCLONES (I.E., STORMS AND TYPHOONS)

Primary Agency: All Agencies
Support Agency: All Agencies

I. Nature of the Hazard

Severe weather systems include thunderstorms and tropical cyclones. A tropical cyclone is a general term for all large circulating weather systems over tropical waters. Tropical cyclones are classified by their intensity and include Tropical Depressions, Tropical Storms, Typhoons and Super Typhoons. 70% of the world's tropical cyclones form in this region of the Pacific. Tropical cyclones can strike Guam anytime throughout the year. A tropical cyclone becomes "significant" with the issuance of the first numbered warning by Joint Typhoon Warning Center as reported by the National Weather Service, Guam. Tropical cyclones in the intensity classifications of Tropical Storms, Typhoons and especially Super Typhoons can cause severe damage and destruction to property and infrastructure as well as cause injuries or death. The longer a tropical cyclone remains near or over Guam the more potential exists for severe damages as structures weaken from extended wind stress, flooding increases and storm surges batter the shores. A tropical storm lingering over Guam for ten hours can sometimes cause more damage and destruction than a typhoon that quickly passes over Guam.

Severe winds are generally categorized into two groups, "damaging wind" and "destructive wind". "Damaging wind" is defined as sustained wind with average speeds between 39 and 57 miles per hour (mph). "Destructive wind" has an average sustained wind speeds 58MPH and above. Weak Tropical Storms generate damaging winds. Severe Tropical Storms, Typhoons and Super Typhoons generate damaging winds.

As a typhoon approaches, the weather could be clear until just a few hours before it strikes Guam, at which time the skies will begin to darken and winds will grow in strength. As a typhoon nears land, in addition to damaging winds, we are very concerned about the dangers of torrential rains and storm surges. A single typhoon can last for more than 2 weeks over open waters and can run a path across the entire length of the Western Pacific. Typhoon season runs from the first of June until the end of November. Yet, typhoons have occurred in every month of the year. Typhoon winds blow in a large spiral around a relative calm center known as the "eye." The "eye" is generally 20 to 30 miles wide with the "eye wall", the immediate perimeter of the "eye", having the strongest winds. However, with large typhoons damaging winds may extend outward 400 miles. Although the weather can be calm within the "eye", the backside of the "eye wall" can be expected without warning with damaging winds coming from the opposite direction.

A. Hazard Agents

The primary hazard agents associated with tropical cyclones are the high, sustained winds; flooding from storm surge or heavy rains; battering from heavy waves; and a variety of secondary hazards.

- **High Winds:** The high winds impose significant stress loads on structures, both direct wind pressure and drag, and tend to propel loose objects at high velocity.
- **Flooding:** Tropical cyclones can cause many different types of flooding. Along the shoreline, the flooding may occur from storm surge, wind-driven water in estuaries and rivers, or torrential rain. The flooding can be still water flooding or velocity flooding caused by wave action associated with wind driven water along the shoreline. The rainfall associated with some tropical cyclones is on the order of 6 to 12 inches, with higher levels common. The rain may precede tropical cyclone landfall by hours and may persist for many hours after landfall, causing severe flooding
- **Heavy Waves:** The tropical cyclone may generate waves up to 25 feet high. These can batter the shoreline, causing devastating damage to the shoreline itself and to structures near the shore. The velocity of the water moving back and forth undermines the foundations of building and piers by removing the soil from around them. Debris driven inland by the waves can cause severe structural damage; persons exposed to the moving water and debris are likely to receive severe injuries.
- **Secondary Hazards:** Tropical cyclones can also cause numerous secondary hazards. Electric power outages are common. Contamination of water supplies, flooding of sewage treatment facilities, and even telephone system failure may occur.

II. Purpose

The purpose of this annex is to provide and identify actions to take

- Prior to
- During, and
- Immediately following a tropical cyclone forecasted to or already impacting the island.

III. Situation and Assumptions

A. Situation

The formation of a Tropical Disturbance can intensify into a Tropical Cyclone (e.g., Tropical Depression, Tropical Storm (Categories A or B), or Typhoon (Categories 1 through 5)) impacting Guam in less than 72 hours (3 days). However, there have been cases of intensification into a typhoon in only 30 hours. Tropical cyclone development and intensification can begin right over Guam. The premise of this annex starts with the understanding that Guam may receive damaging winds (39 mph sustained winds or higher) any time of the year within 72 hours of a tropical cyclone development. The threshold for activation of this plan and annex for government-wide preparedness and response actions is based on the landfall of damaging winds on Guam. However, the Office of Civil Defense, under case-specific direction of the Governor, may provide limited warnings or department/activity specific precautionary actions on a lower threshold such as the onset of damaging winds (39-57 mph sustained winds) or a severe thunderstorm.

The Joint Typhoon Warning Center (JTWC), based in Hawaii, provides track and intensity forecasts for all tropical cyclones in our region. The National Weather Service (NWS), Guam evaluates JTWC forecasts for potential effects upon United States interests in the region, and issues public announcements/advisories about these threats, including thunderstorms. NWS broadcasted information and public media releases include classification (i.e., Thunderstorm, Tropical Disturbance, Tropical Depression, Tropical Storm categories, or Typhoon categories), position, wind strength, precipitation, wave height, and forecast of direction and intensity. The NWS uses the key words, Alert, Watch and Warning, in this order, to describe the increasing concern of a severe weather system approaching Guam. A NWS "alert" announcement indicates a severe weather system formation has started. A NWS "watch" announcement indicates that the severe weather system poses a possible threat generally within 48 hours. A NWS "warning" announcement indicates that severe weather impacts are expected from the approaching weather system within 24 hours. The general public, especially those living in substandard constructed homes, and organizations with planned events may pay special attention to these NWS Alerts, Watches and Warnings.

1. NWS Tropical Cyclone classifications:

- (1) Tropical Disturbance or Tropical Cyclone Formation Alert. Not a tropical cyclone but an area with the potential for development into a tropical cyclone.
- (2) Tropical Depression. A tropical cyclone with maximum sustained winds of 38 mph or less. At this classification a tropical cyclone number is assigned.
- (3) Tropical Storm Category A (weak tropical storm). A tropical cyclone with maximum sustained winds within the range 30-49 mph. Peak gusts are 40-64 mph. At this classification, a tropical cyclone name is assigned, usually after the tropical cyclone's maximum sustained wind speed is 39 mph (causing damaging winds) or higher. A Tropical Depression is within the Category A Tropical Storm classification but does not generate damaging winds and does not usually have a name assigned yet. Typical potential damage from a Category A Tropical Storm includes damage done to only the flimsiest lean-to type structures; unsecured light signs blown down; minor damage to banana trees and near-coastal agriculture, primarily from salt spray; some small dead limbs, ripe coconuts, dead palm fronds, and papaya leaves blown from trees.
- (4) Tropical Storm Category B (severe tropical storm). A tropical cyclone with maximum sustained winds within the range 50-73 mph. Peak gusts are 65-94 mph. A Category B Tropical Storm generates damaging winds when its sustained winds reach 58 mph or higher. Typical potential damage from a Category B Tropical Storm includes minor damage to buildings of light material; major damage to huts made of thatch or loosely attached corrugated sheet metal or plywood; unattached corrugated sheet metal and plywood may become airborne; wooden signs not supported with guy wires blown down; moderate damage to banana trees, papaya trees and most fleshy crops; and large dead limbs, ripe coconuts, many dead palm fronds, some green leaves, and small branches blown from trees.
- (5) Typhoon Category 1 (minimal typhoon). A tropical cyclone with maximum sustained winds within the range of 74-95 mph. Peak gusts are 95-120 mph. Usually "eye" formation begins in a Typhoon. Typical potential damage from a Category 1 Typhoon includes corrugated metal and plywood stripped from poorly constructed or termite-infested structures and may become airborne; a few wooden, non-reinforced power poles tilted, and some rotten poles broken; some damage to poorly constructed, loosely attached signs; major damage to banana trees, papaya trees and fleshy crops; some young trees downed when the ground is saturated; some palm fronds crimped and bent back and many

ripe coconuts blown down; Less than 10% defoliation of shrubbery and trees; up to 10% defoliation of tangantangan; and some small tree limbs downed such as mango; African tulip and acacia. Overall damage can be classified as minimal.

- (6) Typhoon Category 2 (moderate typhoon). A tropical cyclone with maximum sustained winds within the range of 96-110 mph. Peak gusts are 121-139 mph. Typical potential damage from a Category 2 Typhoon includes several rotten wooden power poles snapped and many non-reinforced wooden poles tilted; some secondary power lines downed; damage to wooden and tine roofs but no damage to well constructed wooden, sheet metal, or concrete buildings; considerable damage to structures made of light materials; major damage to poorly constructed, attached signs; exposed banana trees and papaya trees totally destroyed; 10-20% defoliation of trees and shrubbery; up to 30% defoliation of tangantangan; light damage to bamboo; many palm fronds crimped and bent and several green fronds ripped from palm trees; some green coconuts blown from trees; and some trees blown down, especially shallow rooted ones such as acacia, mango, and breadfruit when the ground becomes saturated. Overall damage can be classified as moderate.
- (7) Typhoon Category 3 (strong typhoon). A tropical cyclone with maximum sustained winds within the range of 111-130 mph. Peak gusts are 140-167 mph. Typical potential damage from a Category 3 Typhoon includes a few non-reinforced hollow-spun concrete power poles broken or tilted and many nonreinforced wooden power poles broken or blown down; many secondary power lines downed; practically all poorly constructed signs blown down; some stand-alone steel framed signs bent over; some roof, window, and door damage to well-built, wooden and metal residences and utility buildings; non-reinforced cinderblock walls blown down; many buildings made of light materials destroyed; minimal glass window failure due to pressure forces associated with extreme gusts; chain link fences begin to blow down; light cars begin to be moved and occasionally overturned; a few high-paneled vehicles (buses, vans, etc.) blown over; some unsecured construction cranes blown down; air is full of light projectiles and debris; major damage to shrubbery and trees; 50% of palm fronds bent or blown off; numerous ripe and green coconuts blown off coconut palms; crowns blown off a few palm trees; up to 10% of coconut palms blown down; moderate damage to bamboo; some large trees like breadfruit, monkeypod, mango, acacia, and Australian pines blown down when the ground becomes saturated; 30-50% defoliation of many trees and shrubs; and 70% defoliation of tangantangan. Overall damage can be classified as extensive.

- (8) Typhoon Category 4 (very strong). A tropical cyclone with maximum sustained winds within the range of 131-155 mph. Peak gusts are 168-197 mph. When a Category 4 typhoon generates sustained winds of 150 mph or greater it is called a Super Typhoon. Typical potential damage from a Category 4 Typhoon includes some reinforced hollow-spun concrete and many reinforced wooden power poles blown down; numerous secondary and a few primary power lines downed; extensive damage to non-concrete roofs; complete failure of many roof structures, window frames, and doors; many well-built wooden and metal structures severely damaged or destroyed; considerable glass failures due to flying debris and explosive pressure forces created by extreme wind gusts; weakly reinforced cinderblock walls blown down; complete disintegration of structures made of light materials; most small and medium-sized steel-framed signs bent over or blown down; some secured construction cranes and gantry cranes blown down; some fuel storage tanks may rupture; air is full of large projectiles and debris; shrubs and trees 50-90% defoliated; up to 100% of tangantangan defoliated; up to 75% of palm fronds bent or blown off; many crowns stripped from palm trees; numerous green and virtually all ripe coconuts blown from trees; severe damage to bamboo; many large trees blown down (palms, breadfruit, mango, monkeypod, acacia, and Australian pines); considerable bark stripped from trees; most standing trees are void of all but the largest branches, with remaining branches stubby in appearance; numerous trunks and branches are sandblasted; and patches of panax, tangantangan, and oleander bent over or flattened. Overall damage can be classified as extreme.
- (9) Typhoon Category 5 (devastating). A tropical cyclone with maximum sustained winds within the range of 156-194 mph. Peak gusts are 198-246 mph. Typical potential damage from a Category 5 Typhoon includes severe damage to some solid concrete power poles, to numerous reinforced hollow-spun concrete power poles, to many steel towers, and virtually all wooden poles; virtually all secondary and most primary power lines downed; total failure of non-concrete residences and industrial buildings; some structural damage to concrete structures, especially from large debris, such as cars, large appliances, etc.; extensive glass failure due to impact from flying debris and explosive pressure forces during extreme gusts; many wellconstructed storm shutters ripped from structures; some fuel storage tanks rupture; nearly all construction cranes blown down; air full of very large and heavy projectiles and debris; shrubs and trees up to 100% defoliated; numerous large trees blown down; up to 100% palm fronds bent or blown off; numerous

crowns blown from palm trees; virtually all coconuts blown down from trees; most bark stripped from trees; and most standing trees are void or all but the largest branches, which are very stubby in appearance and severely sandblasted. Overall damage can be classified as catastrophic.

The Office of Civil Defense partners with the NWS and the military to receive advance and direct forecasts of severe weather threatening Guam. In the interest of public safety, the Office of Civil Defense incorporates JTWC/NWS tropical cyclone track prediction uncertainty risk into the decision making process.

When forecasts of strong thunderstorms or damaging winds (39-57 mph sustained winds) are received, the Office of Civil Defense, upon coordination with the Governor, may direct certain situation specific preparedness actions which may be impacted by the severe weather (e.g., cancel a government event, close government schools early, etc.), without disruption to overall government operations. Damaging winds may be generated by Tropical Storm Categories A or B.

When forecasts of Damaging winds threatening Guam are received, the Office of Civil Defense directs government-wide preparedness or response actions which may affect the entire island's population and businesses. Damaging winds can be generated by either strong Category B Tropical Storms or typhoons. Government-wide preparedness or response actions are organized into four action levels. These levels are called Tropical Cyclone Conditions of Readiness (COR) or just "Conditions". These levels are called Tropical Cyclone CORs, not Typhoon CORs, since damaging winds can be generated by both strong Tropical Storms as well as Typhoons. Use of Tropical Cyclone Conditions, or just Conditions, is more commonly used than Tropical Cyclone CORs. These Conditions are implemented or set by the Governor through the Office of Civil Defense in coordination with the military. The setting of each Condition is based on the forecasted onset of damaging winds as follows:

Condition 4 (normal, 72 hours). Damaging winds (39 mph sustained winds or higher) impacting the island are possible within 72 hours. Due to the risk of tropical cyclones developing and impacting the island with damaging winds within 72 hours any part of the year, the normal Condition on Guam is level 4.

Condition 3 (within 48 hours). Damaging winds impacting the island are possible within 48 hours. Condition 3 government-wide preparedness checklists are initiated usually prior to the setting of Condition 3 in order to complete all Condition 3 checklists before Condition 2 is set.

Condition 2 (within 24 hours). Damaging winds impacting the island are possible within 24 hours. Condition 2 government-wide preparedness checklists are initiated usually prior to the setting of Condition 2 in order to complete all Condition 2 checklists before Condition 1 is set. Condition 1 checklists, especially outdoor requirements, are completed simultaneously with Condition 2 requirements.

Condition 1 (within 12 hours or occurring). Damaging winds are expected within 12 hours or are occurring. No outdoor activities allowed, except for extreme emergencies.

Upon the departure of a tropical cyclone's damaging wind threat, and significant safety concerns are resolved (e.g., major roads are cleared of hazards), the island is returned to the Condition 4 setting to allow appropriate general recovery actions to begin.

B. Assumptions

The most predictable natural disaster on Guam is the tropical cyclone. The vulnerability to the people and property on Guam is 100%. Therefore, the entire population, public and private, must prepare for the event to minimize injury and damage, and to better implement recovery.

Advance and direct severe weather predications will be provided by NWS and with partnering, also the military weather services of U.S. Naval Forces Marianas. Upon establishment of Condition settings, coordinated preparation activities by the public, private and military sectors will be conducted. The Office of Civil Defense (OCD) will keep the Office of the Governor informed and appropriate actions will be taken to reduce the damaging wind effect on island residents, businesses and commerce.

Due to Guam's geographic isolation, off-island assistance may not be available for at least 72 hours. Therefore, the island community must work together and utilize all available local resources.

Tropical Cyclone Conditions are set at the authority of the Governor in coordination with the military represented by U.S. Naval Forces Marianas. The setting of Conditions may not be exactly correlated with established time periods (could be set either before or after established time periods) in order to take into account case specific safety or economic situations. Conditions may not be set in consecutive order and may even be reversed as needed to adapt to rapidly changing tropical cyclone data.

The Governor, through the Office of Civil Defense, has the authority to modify, delete or add to any established contingency checklist or procedure, for the purpose of adapting or balancing government actions to needs and risk. Such changes, when necessary, will be publicly announced.

IV. Concept of Operations

All Response Agencies will be recalled at Condition 3, activated at Condition 2 and report to the Emergency Operations Center (EOC) at the Office of Civil Defense for the heavy weather briefs. Response Agencies will then initiate their agency severe weather preparation checklists and their respective agency's Standard Operating Procedures to prepare and respond to the severe weather threat. Agencies will establish a Plan of Action identifying agency preparations securing vulnerable critical facilities, response resources (equipment, vehicles, materials & supplies inventory), response team staffing, needs and resource shortfalls. Updated copies of this plan and checklists will be provided to the Office of Civil Defense.

The Office of Civil Defense will coordinate the activation and manage the EOC before, during and after the tropical cyclone threat. Emergency shelters and mass care will also be considered and managed.

V. Organization and Assignment of Responsibilities

A. Organization

When Condition 3 is announced, a skeleton crew will man the EOC. Upon announcement of Condition 2, Office of Civil Defense will fully activate EOC, and the Response Agencies will report to the EOC to receive initial instructions and report forms. The EOC Director will coordinate all agency tasking and action items under a Unified Command System organization.

B. Assignment of Responsibilities

The activities required to address all emergencies or disasters have been identified as either primary or support functions. The assignment of Response Agency functions has been identified in the Functional Annex Section .

VI. Administration and Logistics

Upon activation of the Response Agencies, the Department of Administration (DOA) manages and tracks all emergency and disaster related expenses. When Condition 3 is announced the Administration and Logistics function of the Unified Command System will begin preparations for response and recovery operations.

DOA will establish emergency accounts for all response agencies to accommodate pre-event preparedness expenditures and activities up to deactivation of the response effort following the emergency or disaster.

The General Services Administration (GSA) will provide the logistics to source, acquire and distribute all response related materials and resources. Along with the Office of Civil Defense, GSA will receive, inventory and manage all response related resources and request for materials by establishing areas to collect, stage and distribute all requests for response materials and resources.

VII. Plan Development and Maintenance

The Administrator of the Office of Civil Defense (OCD) is responsible for the maintenance and revision of this annex.

The OCD will review and exercise this Annex on an annual basis, or as needed. Updates and revisions to the Annex will be made accordingly.

A pre-typhoon season exercise will be conducted sometime between April-June per year as a part of Response Agency readiness activities.

VIII. Authorities and References

A. Authorities

This plan is issued under the authority of, and in accordance with the provision of the Guam Civil Defense Act of 1951, and supersedes the Territorial Emergency Plan of October 1978. References governing the enactment and implementation of this are:

- The Organic Act of Guam, as amended and related statutes, Chapter 8AGuam-Title-48 U.S.C.A. 1422
- Public Law 93-288, Disaster Relief Act of 1974
- Guam Government Code 8501-8515, (Public Law 1-21)
- Guam Government Code 62020
- Executive Order of the Governor 91-09, dated March 25, 1991.
- Guam Government Code 40400

B. References

The following publications/planning documents were utilized in formulating this Plan:

- The Federal Response Plan (9230.1 PL, FEMA)
- Guide for All-Hazard Emergency Operations Planning (SLG 101, FEMA)

IX. Appendices

See Functional Annexes A-O

X. Tabs

- A. Severe Tropical Cyclone Checklist
- B. Severe Tropical Cyclones – Agency Preparation
- C. Total Tropical Cyclone Occurrences