Flawed Service Assessment: South Pacific Basin Tsunami – September 29-30, 2009

Submitted to the DOC Office of the Inspector General for Consideration

Author:

[redacted]

Introduction

The Samoa tsunami of Sept. 29, 2009 was a tragic event in which 140 people lost their lives due to a tsunami generated by a great earthquake. The South Pacific Assessment suggests that PTWC is culpable in this tragic loss of life.

The reality however, is quite the opposite. I will not argue that this event was PTWC's finest. But I will demonstrate that whatever problems PTWC did have during this event, did not contribute to the outcome in Samoa. Moreover, the issues we faced were due largely to the inadequate infrastructure and legacy systems that PTWC has been forced to endure for far too long, and poor management by the NWS. In the ensuing paragraphs I will focus on issues that led to the tragedy as well as the flawed assessment. The points of focus are:

1. The many factual errors and omissions in the service assessment.

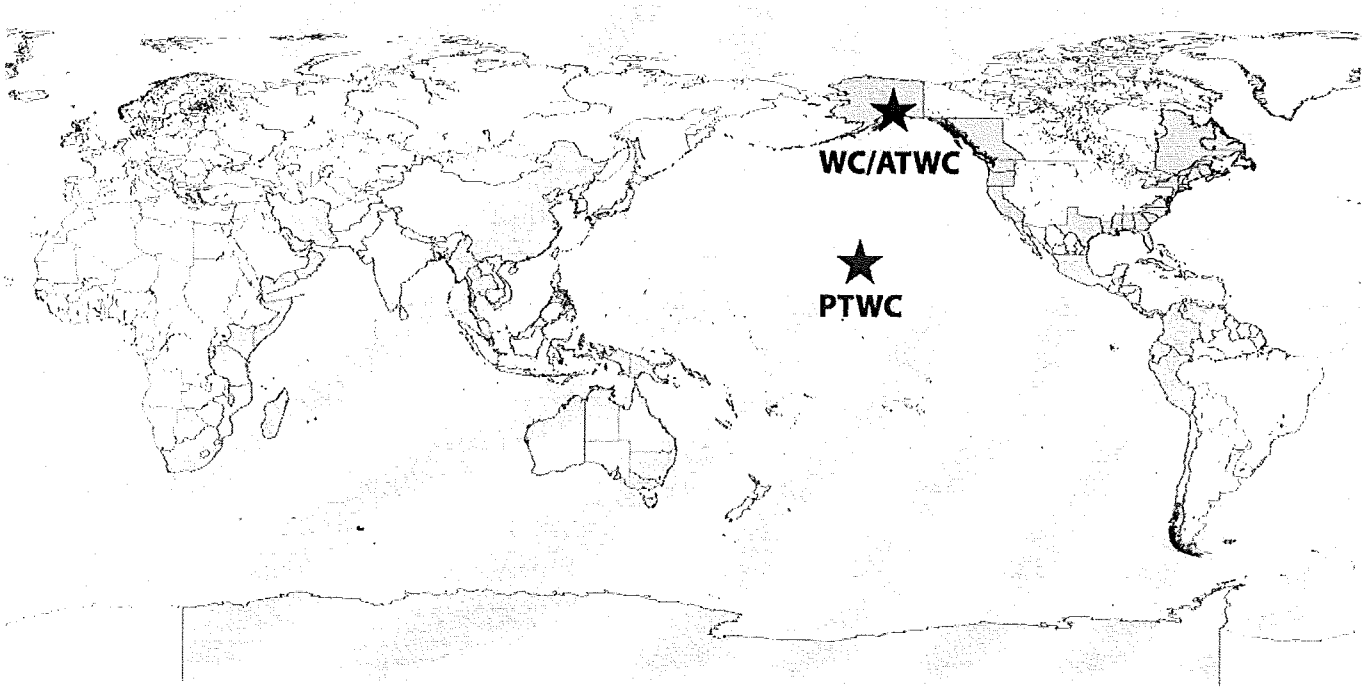
2. The flawed makeup of the service assessment team.

3. The [redacted] report by [redacted].

4. The [redacted] flawed management of the Tsunami program by the NWS[redacted].

Background

The Pacific Tsunami Warning Center in Ewa Beach, Hawaii has been in continuous operation since 1949. Back then, the function of the warning center was to provide advanced notification of tsunamis generated by great earthquakes on the Pacific Rim to the Territory of Hawaii. In the aftermath of the Great Chile and Alaska earthquakes of 1960 and 1964 respectively, the warning center became the hub of the Pacific Tsunami Warning System (PTWS) in 1969. In the aftermath of the 2004 Sumatra tsunami, PTWC has, on an interim basis, become the basin-wide warning center for both the Indian Ocean and Caribbean Sea. Thus PTWC's area of responsibility (AOR) covers 2/3 of the Earth's coastlines:



The West Coast/Alaska Tsunami Warning Center (WC/ATWC) AOR includes the coastlines of North America and Puerto Rico.

In addition to being the basin-wide warning center for much of the world, PTWC also has the responsibility to provide advance warning of tsunamis generated by great earthquakes within the State of Hawaii. The most recent destructive tsunami generated in Hawaii waters was the Halape earthquake of 1975 that had a magnitude of 7.6. There are great differences between the roles of a basin-wide center and a "local tsunami warning center".

A local tsunami warning center has to operate on a very short time scale. If a great earthquake occurs in Hawaii waters, a tsunami could arrive on shore in a matter of a few minutes. PTWC has developed special systems to effectively process earthquakes within the state of Hawaii. But such fast warnings are only possible in areas where the detection networks (in this case, networks of seismometers) are very dense. On the Big Island of Hawaii there are on the order of 100 seismometers, most of them owned and operated by the USGS's Hawaii Volcanoes Observatory and a few owned and operated by PTWC. Given this many instruments on the Big Island of Hawaii, there is approximately an average spacing between seismometers of 2-3 km. Because seismic waves generated by earthquakes travel > 6km/s, PTWC can detect earthquakes on the Big Island typically within 10-15s. And it is thus possible to issue a warning within 2-3 minutes.

On the other hand, for earthquakes outside of Hawaii waters and the US, PTWC and the WC/ATWC rely on the GSN or Global Seismic Network. The GSN isn't really a network, but a cooperative federation of national seismic networks with seismic data contributed by the US, Australia, New Zealand, Russia and many other nations. The typical spacing between seismic instruments that are part of the GSN is on the order of 500km. In some areas like the Southwest Pacific, the spacing is closer to 1000-1500km. As a result of the great distances between GSN instruments in this region, both PTWC and WC/ATWC are limited in how fast they may react. It takes several minutes for seismic waves to traverse the distances necessary so that they are detected at enough stations to allow for analysis of the earthquake.

I mention these two distinct roles, local vs. basin wide, because they represent fundamentally different challenges. What are adequate procedures for a basin-wide center are not adequate for a local tsunami warning center. The executive leadership of the NWS has failed to appreciate these differences [redacted] The fundamental problem with Sumatra [redacted] The lesson the world learned was that a tsunami warning system can not be developed in a few hours. In the case of the Samoa tsunami, the NWS assumed [redacted] that a basin-wide center could or should function as a local warning center on short notice. [redacted]

[redacted] A basin-wide system can't be expected to perform like a local warning system without being informed of this expectation beforehand and given the observational networks and the opportunity to develop appropriate standard operating procedures (SOPs). The differences between a basin-wide and local warning center is more than just the time scales on which they operate. Their SOPs must be different. For example, voice communication is essential (in addition to official bulletins) for conveying a local tsunami warning. PTWC's procedure is that we contact Hawaii State Civil Defense (SCD) via the Hawaii Warning System (an inter-Island intercom that connects PTWC, SCD, Hawaii State Emergency Operations Center, etc.) prior to issuing an official message product. SCD sounds the sirens upon receipt of voice message. The NWS made no provision for this with respect to Samoa. [redacted]

In the true spirit of putting the stop sign up after the accident, the NWS has now installed a hotline between Am. Samoa and PTWC. One wonders how long it will take to get hotlines to Guam and Saipan, also potentially threatened by local tsunamis. Another deadly tsunami?

Factual Errors and Omissions in the Assessment

1. On page 7 of the assessment, it is stated as fact that PTWC issued its Tsunami Information statement two minutes after the WC/ATWC's issued theirs.

It would appear that the NWS assessment writers couldn't be bothered to figure out just what products PTWC issued or at least understand them other than to place them in an appendix. PTWC issued two initial products for this event. PTWC issued an Expanding Regional Watch/Warning (RWW)

Bulletin to its clients in the Pacific Basin (that includes the Samoas), and a Tsunami Information Statement (TIS) to the State of Hawaii. As you might expect, PTWC watchstanders issued the international bulletin first (the RWW) and the TIS to the State of Hawaii second. Unfortunately we cannot determine precisely, i.e., to the second when the bulletins were issued. However, based on the time information on the headers of the email versions of the ATWC and PTWC bulletins (See Exhibit A.), my best guess is that the international bulletin (PTWC RWW) was issued at most ~70-90s (perhaps much less even) later than, and not two minutes, after ATWC's TIS. It would appear that the Assessment authors arrived at the two minute figure by looking at the date-time group, under the header of the bulletins, which are two minutes apart. However, these times are truncated in that seconds are not presented. So it is in fact possible, based on just that information, the bulletins could possibly only be 61s apart. In fact as I will discuss below, it might even be less.

The international bulletin was followed soon after by the TIS issued by PTWC to Hawaii. In any event, it is unfair to compare the RWW with the WC/ATWC TIS. A TIS is basically a one pager, (see Samoa Assessment Appendix F). An RWW bulletin is composed of several sections (See Samoa Assessment Appendix F). The watchstanders, after the coordination call with WC/ATWC to agree on parameters, then must compute tsunami travel times, a procedure requiring 15s of computation (and which WC/ATWC did not have to do for their TIS) and then, finally, inspect this product before issuing it. As you might suspect, this product is one of great gravity and PTWC watchstanders make sure all is in order before releasing the bulletin.

To sum up, the assessment is in error and omitted key facts. Although the assessment does contain these message products in the appendices, it fails to take into account the differences between the products and procedures of the TWCs for this event in criticizing the PTWC.

2. (Page 7) Fact: WC/ATWC and PTWC arrived at their perspective initial earthquake parameter assessments in different times and different degrees of accuracy.

This is true. What is omitted is that PTWC issued the first message (observatory message) for this earthquake before any other organization. I should also point out, that seismological observatories rarely, if ever, are in 100% agreement on the parameters of the Earthquake. Reading the assessment one gets the idea the NWS thinks measuring earthquake parameters is like getting a Turkey's temperature on Thanksgiving. Its more complicated than that.

Unfortunately the initial magnitude, based on watchstander misjudgment, was deficient. However, as I will demonstrate later, this turns out to be immaterial. The observatory message is an unofficial product; it is supposed to be our first firm assessment of the earthquake's location and magnitude. There is no mention of the observatory or earthquake messages in the document governing our responsibilities NWSI 10-701. Why is PTWC being criticized for a message product, that according to official guidelines doesn't even exist? The TWC's engage in the practice of sending these messages as a way of sharing information and analysis with our partners who send us information and as a way of testing our communications circuits. There is no official responsibility to do so.

Much to our surprise, Am. Samoa was using this message as a proxy for a local warning bulletin. PTWC was never informed about this procedure and this fact is not stated in the assessment. [redacted]

The assessment also omits the fact that the watchstanders did realize they underestimated the earthquake magnitude within two-three minutes after issuing the observatory message. Exhibit B. shows output from one of our magnitude estimation programs where the magnitude is substantially larger than what was first thought.

But the basic problem here was that PTWC was not involved in the discussions that led to the A. Samoa WFO use of the observatory message. A. Samoa was using our RWW bulletin threshold of M>7.5 as a basis for issuing a tsunami alert in Samoa for an earthquake close to Samoa. However, the M>7.5 threshold is much too large a threshold for a "local tsunami warning". Areas in the near field of an earthquake should have much smaller thresholds for issuing warnings. Here in Hawaii, PTWC issues warnings for earthquakes as small as 6.9, and the WC/ATWC will issue warnings to the Gulf Coast for earthquakes as small as 6.5. Indonesia has similar thresholds for quakes in Indonesian waters. Under proper circumstances, i.e., having the correct SOPs for a local tsunami warning system in place, even PTWC's initial magnitude which was deficient at 7.1, should still have been great enough to trigger an evacuation of Samoa's coastlines. The NWS failed to appreciate the difference between a local tsunami warning system and a basin-wide tsunami warning system.

3. (Page 7.) Finding 1 – There is a low density of seismic sensors in the Samoa region, contributing to the delay in warning issuance with respect to other domestic regions.

How is it possible that the NWS leadership was not aware of this until after the disaster?

4. (Page 7.) Fact: There is no redundancy to back up NOAA-NET.

To provide 100% availability it is essential that a warning system avoid single points of failure. This means redundant communications. For years the PTWC was bandwidth limited compared to the WC/ATWC, despite having 2/3 of the world in the PTWC AOR. This means we could not bring in as much seismic data. At the time of the Samoa earthquake, PTWC only had one reliable means of receiving seismic data and that was over NOAA-NET, a private WAN (wide area network) maintained by NOAA. There was another network called CRESTNET, a private WAN that included the TWC's and certain USGS centers. CRESTNET had a very limited bandwidth, only 15-20% the capacity of NOAA-NET. [redacted]

[redacted] This stems from the fact that such infrastructure must come from the TWC's region within the NWS, and since Pacific Region is apparently more strapped for funding than the Alaska region, we are always behind in getting improved infrastructure with respect to ATWC.

5. (Page 8.) Fact: "Soon after the earthquake occurred operations became negatively affected when additional people gathered in the operations area. Additional PTWC staff arrived shortly after being paged, adding to the total number of people present: media representatives also interacted with operational staff. This number of people resulted in too may concurrent conversations by those present and on the 5 phone lines, which were being used continuously."

This paragraph gives the impression of a time-line and blurs a number of issues, some real, some imagined by the authors. In particular it gives the impression that the media were already present when additional PTWC staff arrived. Let us be clear, the media didn't arrive until about an hour after the event. By this time, PTWC had already issued the observatory message and the first bulletins. The media did not interfere with our ability to do our jobs.

As one might expect, there is a Samoan community here in Hawaii, and they were rightly concerned about their loved ones. We were flooded with frantic phone calls, and PTWC watchstanders answered as many as they could with the most up to date information they had. Keep in mind, that by this time, the tsunami had already struck and we also had issued our first bulletins.

The assessment also charges that "Extra staff members who arrived at PTWC to assist with the event were not assigned to fulfill specific functions..." and implied there was no "Event Coordinator". [redacted] The PTWC Director Dr. Charles McCreery was the event coordinator. Standing rules are that if present, either the Director or the

TWSO [redacted] oversees PTWC's response to the event. If neither is present, then the Senior Watchstander on duty has that responsibility. With respect to people filling assigned roles, both of PTWC's Oceanographers were running the forecast models [redacted] was tracking sea-level data. The Director and some other staff were trying to resuscitate some of our message circuits (more on that later) and issuing bulletins. Everybody else was answering phones or addressing the media. The Director conducted interviews later. Seems to me, people were doing exactly what they were trained to do.

The NWS is upset because as stated in the assessment on page 8., "PTWC operations area became increasingly chaotic, due to continuous phone calls, the presence of a police officer [we all know how the police contribute to chaos (my comment)], members of the media ....". However, the NWS doesn't seem to recognize that PTWC is hamstrung by an aging infrastructure. We have little space, and because our electrical infrastructure is inadequate we do not have any where near the screen space we should have. More screens mean more information can be displayed. Much of the milling about by some of the staff seen in some footage, is due to the fact that they are trying to get information, and if it can't be displayed on screens they need to consult with people keeping their eye on the event, like myself, the Director and the Oceanographers. From my perspective, that was a much larger problem than the media. So when the assessment states on page 8., "The lead watchstander [actually the Director assumed the role of lead (my comment)] lacked an efficient means to collect and share vital decision support information with high priority users", it actually stumbles, finally, onto some real facts. However, it failed to identify the root cause behind this issue, and that is lack of infrastructure.

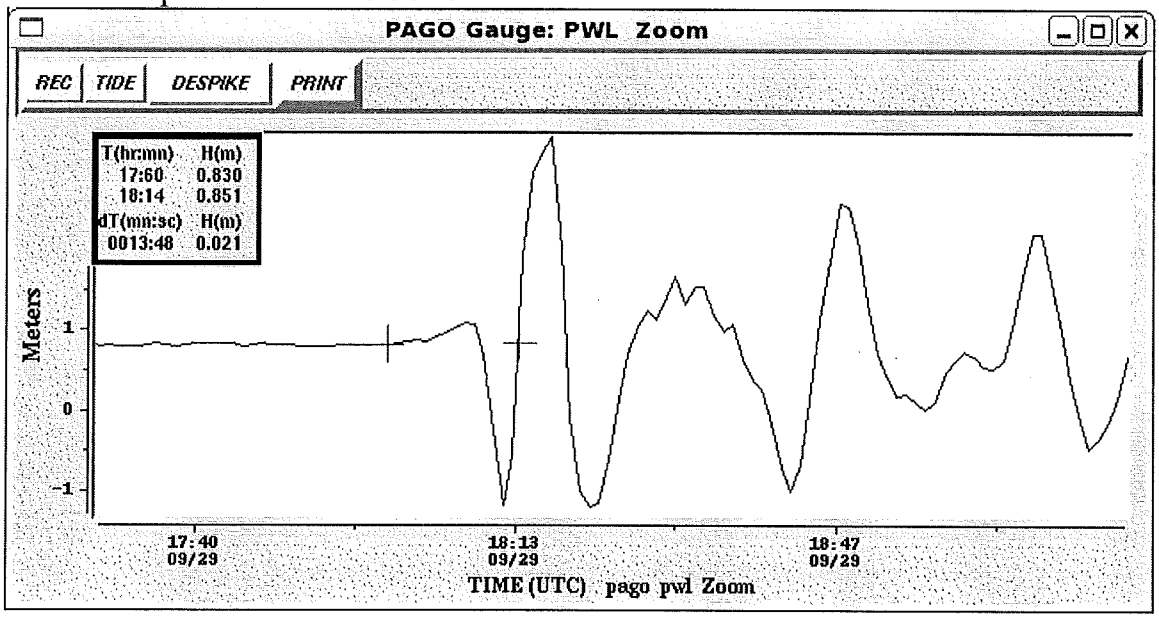
6. (Page 10) Fact: "PTWC's website experienced a major slow-down at approximately 8:30 a.m. HST. As a result, many users were unable to obtain critical Web-based information for at least 3.5 hours."

I object to the characterization "PTWC's website". This gives the impression that PTWC maintains a website. It most certainly does not. That the NWS is too incompetent or unable to devote the resources to properly manage a website, is not PTWC's fault, however much it was our problem.

7. (Page 15) Fact: "The first tsunami waves were observed in Pago harbor at 7:05 AM local time (18:05 UTC), 17 minutes after the earthquake".

This leaves one with the impression that the hazard in Pago Pago harbor started about the same time as the receipt of PTWC's RWW, meaning that PTWC's bulletin was ineffective because it was too late. This misleading, false impression is inexcusable.

The NOS sea-level station in Pago-Pago showed that the tsunami arrived at 17:59 UTC time. However, what is not stated in the assessment is that the first wave was small, only several centimeters. Soon after that, the draw-down of the ocean commenced (ocean receded from the shore). The draw down lasted about 10-12 minutes. This can be seen in the marigram (sea-level curve) measured at the sea-level station in Pago-Pago and displayed by PTWC's operational software:



This marigram is corrected for the tide, so that the sea-level variation shown here is due to the tsunami and not the effects of the tides. The tsunami arrives at approximately 18:00UTC or 7AM Samoa time Sep. 29, 2009. A few minutes later the drawdown commences. Sea-level does not climb back to its pre-tsunami level until approximately 18:14 UTC. That is 10 minutes after PTWC issued its RWW bulletin at 18:04.

The assessment is technically correct in stating that PTWC's first official bulletin wasn't received until about the same time or just after the tsunami arrived. However, it omits the fact that the hazard itself didn't actually materialize until 7-10 minutes after receipt of the bulletin. The information

presented on page 15 of the assessment does not agree with the data showed by the Pago-Pago sea-level station above.

Why was this easily obtainable fact omitted [redacted]

8. On page 21 of the assessment it is stated, "At the time of this event the official PTWC definition of the tsunami advisory differed from the corresponding definition in the WC/ATWC AOR."

The difference was in PTWC's Hawaii product! Forgive me, but who is the customer here? The State of Hawaii or the NWS? The definition in use at that time was crafted with input from Hawaii State Civil Defense, and the Hawaii State Tsunami Advisers.

9. Fact: On page 23 of the assessment it is stated that "PTWC tsunami watch/warning bulletins for the Pacific (WEPA40 PHEB) were not consistently issued at least hourly as required by NWSI 10-701."

This is true. PTWC watchstanders are guilty of spending too much time trying to resuscitate the AFTN and the NWW circuits that depend on legacy technology, before issuing the products. We have pleaded with the NWS to have these legacy systems (our AFTN terminal runs on a Pentium II!). In fact the AFTN and NWW systems at PTWC need to be rebooted over 100 times a year. The reason for putting the Tsunami Warning Centers in the NWS is because of the NWS's highly capable communications infrastructure [redacted]

10. Fact: On page 23 of the assessment it is stated that "PTWC staff were made aware of this fact by a call from ATWC".

In truth PTWC staff were aware at about the same time ATWC called. Obviously you need to wait a period of time before you declare a message was not sent as delays in receiving the message back over these circuits can be up to two minutes (and occasionally more). PTWC staff were surprised in that the observatory message sent via the AFTN was successful, while the

official bulletin sent only 9 minutes later was not. ATWC's staff as well, was not answering phone calls [redacted]

This concludes my discussion (or dissection) of fundamental issues with the assessment itself. I also have fundamental issues with the way assessment was handled, and I do not believe the handling of the assessment was based on fair, let alone good, business practices.

Flawed Makeup of the Assessment Team

For starters, with exceptions of [redacted] none of the members on the assessment team had any practical experience with tsunami warning systems and/or Geophysics. The rest were Meteorologists. From my point of view, if an organization asked me to sit on an assessment team to examine the actions of a WFO, I would refuse. Why? I don't know much about a WFO or Meteorology. The NWS can't claim they wouldn't know who to contact; after all, the NWS was well aware of the composition of the NAS panel which recently issued its report on "Tsunami Warning and Preparedness". There were a number of individuals on that panel who could comprise a fully qualified assessment team.

[redacted]. I thought reviews were supposed to be made by independent agencies, or people who do not have a vested interest in the outcome. That didn't seem to be the case. This was an extremely foolish thing for the NWS to do. Suppose the WC/ATWC needs an assessment. What happens then? Does the PTWC Director get to sit in judgment? In my view this has compromised, rather enhanced, the NWS management of the Tsunami Program. In fact, it damn well could have damaged the cooperation between the two centers on various issues, like data sharing and communications vital to the warning system.

The NWS would have been better served, by putting personnel from River Forecast Centers on the assessment team. The RFC's have many similarities in the way they conduct business, to the TWC's. For example, the RFC's

write their own software, and use their own in-house systems. Why the NWS appears vexed that the TWC's function this way and doesn't seem to mind that the RFC's operate similarly I find quite odd. I will bring up the subject of the RFC's again in the final section.

To understand why the Assessment contains the errors it does, one only need note that the report was never fact checked by PTWC, as required in NWS Directive, NWS Instruction 10-1606:

From Section 6.3.1

" The draft report is sent for review to the affected regions, NCEP, WFOs/RFCs/Center Weather Service Units (CWSU), and others impacted by the event. Findings and recommendations are sent to the NWS Training Division for early identification of potential training issues. Confidentiality requirements will be followed....."

before it was presented to NWS HQ. Last I heard, Pacific Region was one of the affected regions and PTWC is a "WFO" in this instance. This has resulted in considerable misconceptions on part of the NWS leadership.

Are NWS directives ornaments? Only to be followed when things go perfectly well? The assessment was signed by NOAA's legal eagles. Does NOAA's legal team believe that NOAA is not legally obligated to follow its own guidelines?

I find it interesting that the GAO (report GAO-10-490 04/18/2010) lauds our performance (see footnote on page 20 of the above GAO report), [redacted]

Its worth repeating that I'm not claiming this is PTWC's best event. However, it is disconcerting to see the NWS throw us under the bus [redacted]

Scott Report

Before critiquing the Samoa Tsunami Follow-On Actions Report by Carven Scott, I'd like to say a few things regarding the conduct of his investigations. [redacted]

[redacted]

[redacted] described him as belligerent and needlessly provocative. Most were under the impression that he was there to *kick ass* rather to find anything useful that might benefit PTWC in the future. [redacted]

[redacted] did identify some issues with the Tsunami Management Program that I have discussed above. However, [redacted] proposes a JTWCD, "Joint TWC Director". What I wonder, is the Tsunami Program Manager supposed to do? I suspect such a person would be equally ignored by the NWS leadership as is the current one.

[redacted] Did we fail to issue a bulletin inside 20 minutes in accordance with our documented requirements? How fast should we issue bulletins? If the NWS thinks we should issue faster, then lets have a discussion as to how fast is fast. Without due consideration, an emphasis on speed would inevitably lead to a race to the bottom, where speed becomes a priority at the expense of quality. Since the NWS lacks the inclination to have this conversation, Dr. Nathan Becker of PTWC has addressed this issue and presented the results of his study at the December 2010 AGU (American Geophysical Union) meeting in San Francisco (https://sites.google.com/site/nathancbecker/presentations/agu-poster-2010).

Also on slide #9, it is stated "Lack of training, simulation, and testbed capability at PTWC". Again, this is a half truth. PTWC's operational software can examine any previous earthquake which is adequate to train our staff. We can't simulate an event in real-time. We do have a testbed, however, it is being used to migrate our software from Solaris to LINUX.

Scott never bothered to ask why. Our infrastructure can't support a system identical to ATWC

On slide #12, "Install WCATWC earthquake analysis system at PTWC in parallel (for risk reduction) with existing system". If we did that PTWC would burn to the ground. It is worth pointing out again, that the assessment found no issues with our hardware or software (page 7.) Our electrical infrastructure could not support it. So why is [redacted] pushing the ATWC system so hard I wonder? In fact, a number of sweeping statements are made in slides 12-14, which require discussion [redacted]. Oh, and by the way, to my knowledge the observatory message is still not an official message product.

Furthermore, despite protestations to the contrary from ATWC, their system is largely untested. PTWC has issued more watch/warnings for its AORs in the last 6 years, than ATWC has in its entire history. They have scarcely been tested under fire.

I was particularly impressed with slide #17 where [redacted] plays physician in criticizing our standby model where the standby watchstander can be asleep at night as opposed to two people performing the graveyard shift as at ATWC:

"People awakened during deep sleep do not adjust immediately and often feel groggy and disoriented for several minutes after they wake up." *NIH Publication Number 06-3440-C*

[redacted]

What he fails to include are links to many studies which show a connection between cancer and graveyard shift work. For example:

http://www.usatoday.com/news/health/2007-11-29-night-shift-cancer_N.htm or http://monographs.iarc.fr/ENG/Monographs/vol98/mono98-8.pdf

[redacted] I would point out that the PTWC shift/standby model has enabled PTWC to keep its valuable staff intact. I am proud that every scientist PTWC hired since 2005 is still working for PTWC. ATWC cannot say the same. Since 2005, several staff members have come and gone, not including retirements. The reason generally has to do with the ATWC shift model. Neither the cancer link or the turnover at ATWC is mentioned in Mr. Scott's report.

PTWC issued a Tsunami Information Statement within 3 minutes of the Kiholo Bay earthquake which occurred on Oct 15, 2006 at roughly 7am HST. This was the largest earthquake since the 1975 Halape earthquake mentioned in the introduction. This type of event was the most severe test of a US TWC for an earthquake on US soil in decades. The PTWC standby/shift model worked then and it worked for the Samoa event.

[redacted]

[redacted] I'll just summarize it by saying it totally missed the big picture and that is the poor state of our infrastructure. I don't see how anybody can miss that. [redacted] was the basis for the NWS almost declaring that PTWC was "non-operational". [redacted]

Flawed Management by the NWS

Where do I begin? Prior to 2006, there was no "National Tsunami Program". The tsunami warning centers were funded not as a national program, but at the whims and desires of the Pacific and Alaska regions. Funding for certain improvements to PTWC was a result of a line item inserted into the federal budget by Hawaii's congressional delegation. We were not part of the NWS baseline budget (other than FTEs and facilities) until after 2005, when the NWS realized they could utilize PTWC's fame and credibility following the

Sumatra Tsunami of Dec 26., 2004 and [redacted] us to acquire more funding. [redacted] The NWS used PTWC's visibility to get the tsunami program put in the NWS's baseline budget.

While Pacific Region seems perennially strapped for funds, ATWC has enjoyed enormous backing from the Alaska region. To wit, ATWC has two extra employees (granted they are term) for IT (Information Technology) and computer programming work. Pacific Region does not have the resources to do the same for us (and even if it did, we would be hard pressed to find resources for them). [redacted] Currently, PTWC is being criticized for being behind in terms of IT security. PTWC does not have a full-time ITO (Information Technology Officer). When PTWC was given the opportunity to expand its staff back in 2005, we unsurprisingly, opted to fill these positions with qualified watchstanders. After all, we had two thirds of the world to look after, and a huge influx of new clients that we had to deal with. Also at this time, the IT security burden was not anything like it is today. The ATWC ITO does not stand watch, and works solely on IT and software issues. PTWC has asked for an ITO position, however, we have been denied. I have to ask again, why did it seem appropriate to give PTWC the same number of positions as ATWC, when our responsibilities greatly outstripped theirs?

When PTWC was given responsibility for the Caribbean, that included Puerto Rico. However, Puerto Rico was taken away from PTWC's AOR and given to ATWC. [redacted] made PTWC's lack of bandwidth an issue in giving Puerto Rico to ATWC's AOR. So this is how it is in the NWS. One office is underfunded, its infrastructure not taken care of properly and other NWS offices are entitled to take advantage of the situation.

The basic problem with the NWS tsunami program is that nobody is really running it. The NWS tried to manage it as an afterthought and failed. [redacted] was appointed Tsunami Program Manager, and is the nominal head of the Tsunami Program. [redacted] was a quick study and has mastered

the nuts and bolts of the tsunami warning business. However, with respect to funding, [redacted] only controls the Spectrum Funds which are being used for the Tsunami Warning Centers Modernization program. The TWCs are still dependent on their respective regions for infrastructure and other support. Before [redacted] was the Tsunami Program Manager[redacted]

Unfortunately, when it comes to big decisions regarding the tsunami program, the NWS executive leadership tends to ignore the Tsunami Program Manager. For example, I know via personal communication with [redacted] that it was her wish to send an assessment team to PTWC comprised of independent experts but was ignored by the NWS. The Tsunami IT Modernization Project, was being managed by [redacted], however, after two years the NWS transferred this project [redacted] That is fine I suppose, but why did it take the NWS two years to figure this out?

Currently we understand that [redacted] is threatening to shut PTWC down because of our non-compliance with NIST IT security guidelines. Once again PTWC gets blamed for the results of managerial incompetence. A great many of the IT issues we have, have to do with physical security issues which we cannot possibly address given the sad state of our current infrastructure. Exhibit C. shows an email exchanged [redacted]

The NWS had decided several years ago not to improve PTWC's infrastructure because PTWC is slated to be moved to the Pacific Region Center (PRC) facility being built on Ford Island in Pearl Harbor (move in date sometime in 2013?). All of the physical and IT controls mandated by the NIST standards are incorporated into the TOPs project and the design of our physical space within the PRC. PTWC is now bearing the brunt of this decision not to improve our infrastructure because of the impending move to Ford Island. I can understand the basis of this decision; the NWS felt it would be throwing money away to improve our infrastructure only to have PTWC move away a few years later. However, the NWS does not accept the consequences of this decision that has us now placed in jeopardy.

To illustrate this, I've included a picture of our operations center as it appeared for more than two months while Pacific Region made arrangements for two new air conditioners. Because two of PTWC's main AC units failed, we had portable AC units and fans in our operations center for over 8 weeks. Repairs were recently concluded. During this period we lost several disk drives, monitors, and one major computer system. The most likely cause is over-heating.

The NWS has to stop doing things "on the cheap", or understand that it gets what it pays for. The Assessment wasn't the NWS first attempt to assess the tsunami program. The first attempt was several years back and was published in the [redacted] report. However, [redacted] did not know anything about the tsunami warning system or tsunamis. Hence it is obvious that they were the perfect people for the job (yes that is sarcasm). I understand that the NWS wants people who are objective and independent to conduct these studies (except in the case of the Samoa assessment apparently). [redacted] NWS to just once find people who are that but not entirely ignorant of what we do?

This was not fair to [redacted] or PTWC. They were at PTWC for two days. Most of that time was spent learning about the tsunami warning system and tsunami not leaving much time to learn about our systems. This is obvious from reading the report. Once they arrived at ATWC, where they spent more time, and not needing lectures about the warning system and tsunamis, they were able to devote much more time learning about ATWC's systems and that too is obvious from reading the report. I've enclosed a copy of the letter I wrote to PR Director Jeff Ladouce (Exhibit D.) concerning the erroneous and corrosive effect this report has had on our reputations. [redacted] Among the comical statements are remarks claiming that our systems are under utilized because typically only a few percent of the available CPU cycles are used. Clearly these gentlemen did not grasp the episodic nature of our business, because when there is a large earthquake, that extra CPU power comes in handy. I objected to this report as it was quite flawed.

[redacted]

Where does this all end? In the past year, we have had the Assessment team visit, [redacted] visit, The Workforce Study (the results of which will probably be ignored) etc. There have been 9 assessments/studies that have involved the TWC's over the past two or three years. All of these disruptions and for what? Even the NAS review had major issues. [redacted]. Nothing the NWS does with respect to the overall management of the tsunami program is without peril.

[redacted]

[redacted]

To wit, there were no emergency managers or anyone with a social science background on the NAS panel from Hawaii, the state which, incidentally, has the most experience with emergency preparedness for the tsunami hazard. A meeting of the NTHMP (National Tsunami Hazard Mitigation Program) panel was held during first week of February 1,2 2011, where the recommendations were put to a vote. The Watch product was kept.

[redacted]

The NWS is now considering starting a third TWC in Puerto Rico. [redacted] The current TWC's are more than capable of monitoring seismic activity and tsunamis in the Caribbean. To fold in another TWC in the current NWS framework would be ridiculous. The NWS has trouble enough with two TWCs. Three would simply aggravate the already existing problems and add another *turf* to war over. Under no circumstances should another TWC be put into operation until the current management issues are [redacted]

Finally, I will bring up the subject of NOAA-NET, the private wide area network that is maintained by NOAA. It takes up to two weeks to get approval for changes to the NOAA-NET firewall (even when marked expedited) so that the TWCs can bring in seismic or other data from outside networks. I can understand the need for security, but this is ridiculous. The USGS can accomplish the same thing within the Dept. of the Interior in 48 hours. How is it possible that the NWS which is supposedly an organization with a 24/7 responsibility can't get a firewall change approved for two weeks while the USGS which has no such responsibility can accomplish this in 48 hours? [redacted]

[redacted]

Concluding Remarks

A pattern of petty favoritism within the NWS started some time ago, continues unabated, and is simply too great to ignore. A number of PTWC staff were awarded NOAA Bronze Medals for their actions during the Sumatra tsunami. A number of ATWC staff were awarded NOAA Bronze Medals for expanding ATWC's AOR to include all of North America. Funny, we expanded our AOR to include another ocean basin (Indian), the South Atlantic and the Caribbean Sea. I would dare say that involved a much greater time and effort than what ATWC had to expend, but we don't seem to get any credit for that. Indeed, by May of 2005, PTWC had already put together a basin wide system in the Indian Ocean. It seems to us that the executive management of the NWS cares rather little about our international obligations now that it has obtained what it wanted by publicizing them.

PTWC was criticized in the [redacted] report for our Standby/Shift model. One should consider the model used by the NWS River Forecast Centers (RFCs). The RFC's operate in a 16x7 mode, that is 16 hours per day, 7 days a week. The RFC's duty rotation uses 11 watchstanders, with 3 management personnel who can fill in as needed. The TWC's have 12 watchstanders for 24x7. The TWC's if they are to operate with two watchstanders on shift, should have at least 1/3 more watchstanders than the RFC's as we operate 24x7 and not 16x7. That means the TWC's should be staffed with at least 14-15 watchstanders, plus three management positions. The real issue isn't the manner in how the TWC's cover their 24x7 operations as claimed in the [redacted] report, but how the NWS has taken advantage of the TWC's in chronically under staffing them and has been ignoring or hiding this fact.

The assessment, while a good idea in the sense that any tragedy should be analyzed, was botched by the NWS. It was ill-managed; the assessment team was poorly composed, its findings not fact checked, the espirit de corps within the tsunami warning system was damaged and the assessment unnecessarily called the credibility of the PTWC into question. The NWS implicitly assumed that a basin-wide warning center should function as a

local warning center without the need to establish formal procedures or the needed observational networks to support such an endeavor beforehand.

My recommendation is that the Tsunami Warning Program (TWP) be made its own line office within NOAA. Suitable memoranda of understanding can be drafted such that the TWCs have full access to the NWS telecommunication centers. In addition there may be some benefits to combining the NOS with the Tsunami Warning Program. Currently, as recommended by the NAS (a poor recommendation at that) the NWS is moving the TWP to NCEP. However, playing hot potato with the TWP will not fix the structural problems. Embedding the TWP within another NWS agency (also unfamiliar with the operations of a TWC) hardly seems like a solution [redacted]

Last, the NWS needs to make a decision as to whether it will have and support a national TWP, or have two (or three) separate TWC's functioning under the guise of a national program. The NWS pretends it has the former, while in reality it is the latter. The NWS has had several years to correct the structural defects in the TWP in terms of management and support. Instead the NWS blames the TWC's for the problems and has demonstrated scant leadership to resolve the overriding issues.

[redacted]

I appreciate your time and consideration.

[redacted]

[redacted]

Exhibit A.
These are headers obtained from the emails I received of PTWC's RWW bulletin and ATWC's TIS bulletin.

First, the header on the emailed ATWC bulletin:

from relay-east.nems.noaa.gov ([140.90.121.175]) by vmail2.nems.noaa.gov (Sun Java System Messaging Server 6.2-7.05 (built Sep 5 2006)) with ESMTP id <0KQQ000JJWVP9830@vmail2.nems.noaa.gov> for [redacted]; Tue, 29 Sep 2009 14:33:25 -0400 (EDT)
from mx-east.nems.noaa.gov ([140.90.121.147]) by relay-east.nems.noaa.gov (Sun Java System Messaging Server 6.2-3.04 (built Jul 15 2005)) with ESMTP id <0KQQ003LMWVMD7U0@relay-east.nems.noaa.gov> for [redacted]); Tue, 29 Sep 2009 14:33:25 -0400 (EDT)
from infolist.nws.noaa.gov ([140.90.19.83]) by mx-east.nems.noaa.gov with SMTP; Tue, 29 Sep 2009 18:03:25 +0000

I realize this is a jumble, but the crucial part is the last line which shows the NOAA email system (nems.noaa.gov) received ATWC's email of the TIS at 18:03:25. This strongly suggest the ATWC message was emailed close to 18:03 if the header on the ATWC TIS is accurate.

This is the header on the emailed PTWC bulletin:
rom relay-east.nems.noaa.gov ([140.90.121.175]) by vmail2.nems.noaa.gov (Sun Java System Messaging Server 6.2-7.05 (built Sep 5 2006)) with ESMTP id <0KQQ000LTWXW9830@vmail2.nems.noaa.gov> for [redacted]
Tue, 29 Sep 2009 14:34:44 -0400 (EDT)
from mx-east.nems.noaa.gov ([140.90.121.147]) by relay-east.nems.noaa.gov (Sun Java System Messaging Server 6.2-3.04 (built Jul 15 2005)) with ESMTP id <0KQQ003OZWXPD7U0@relay-east.nems.noaa.gov> for [redacted]
(ORCPT [redacted]; Tue, 29 Sep 2009 14:34:44 -0400 (EDT)
from infolist.nws.noaa.gov ([140.90.19.83]) by mx-east.nems.noaa.gov with SMTP; Tue, 29 Sep 2009 18:04:19 +0000

In this case the NOAA email system, received PTWC's email of the RWW at 18:04:19. This means our bulletin could not have been sent later than 18:04:19 and probably at least several seconds earlier.

Exhibit B. Output from PTWC's Magnitude estimation program

```
/home/twseis-r/mwpResults          Tue Sep 29 17:56:59 2009          1


[makeOutfileHeaders]: STARTING AT:
Tue Sep 29 17:56:59 GMT 2009

CONTENTS OF PTWCHOME/COMF:

                HEADER                                  DAY HR MN SC MO YEAR
              GMT_TIME                                   29 17 48 11 09 2009
               EQ_LONG                                              -171.50
                EQ_LAT                                               -15.27
                 DEPTH                                                  033


AVERAGE MWP (6 STATIONS) =  7.53
 STANDARD DEVIATION = 0.64

 1 AFI    bhz      7.420     -0.110
 2 NIUE   bhz      6.740     -0.790
 3 RAR    bhz      7.260     -0.270
 4 TARA   bhz      7.160     -0.370
 5 SNZO   bhz      8.310      0.780
 6 KHZ    bhz      8.290      0.760


AVERAGE MWP (0 STS1'S) =   NaN
 STANDARD DEVIATION = -0.00
```

Eliminating the outlier (NIUE station) the watchstander obtained a magnitude of approximately 7.7. Large enough to warrant a issuing a RWW. The time at the top of this summary sheet indicates this was understood by the watchstanders about 8-9 minutes after the earthquake.

Exhibit C. Letter from Roger Gernold

[redacted]

I recommend we purchase a new rack and either complete the PTWC electrical upgrade or wait for a lot of our current systems to be removed before purchasing a chassis system like the m1000e. Our old shallow depth racks are not going to be able to accommodate this chassis with it's combination PSU's and PDU's. We need a modern rack with the square mounting holes and greater depth. See page 34 of the Tech. Guide.

Our old building does not have the UPS power you need to run this. The chassis requires 220 volt service and we currently only have 120 volt service. The electrical upgrade should be completed on the building with the addition of these extra breakers. Were you planning to order the recommended 3 phase system that requires 3 x 30 amp breakers at 220 volts?

I don't know how many power supplies you plan to buy or servers you are going to put in it. That will determine the total power draw. If you fill it up and we need two PDU's, the manual says it could draw 28 amps. If you add to that 2 amps for the SAN and .6 amps for the backup solution, we are over 30 amps and we currently have none to spare. That is assuming we want to migrate off of our current redundant system before we turn them off.

It seems as though we are caught between a rock and a hard place. We have a deadline to upgrade our IT security but don't have the infrastructure to do it.

[redacted]

Exhibit D.

[redacted]

[redacted]

I thank you in advance for allowing me the opportunity to clear up what appears to be some lingering misconceptions about our operations. Back in April, when there was a meeting at PTWC which included Laura Kong, Jack Hayes, yourself and Chip, you had used the word "kludge" in conjunction with our operations. It has come to my attention that this issue has surfaced again more recently. Hence, rather then be content with the discussion we had back in April, it appears that it may be beneficial to discuss this issue in more depth. I'm not sure where you got the impression we have kludges in our operations. I may be completely wrong, but I suspect you got this impression from [redacted], since it is obvious from his review he thinks our ops are kludged. Please correct me if I'm wrong.

A common working definition of "kludge" is:

In information technology, a kludge (pronounced KLOOdzh) is an awkward or clumsy (but at least temporarily effective) solution to a programming or hardware design or implementation problem.

We have integrated various tasks (data ingestion, data processing, message creation and dissemination etc.) into a robust, cohesive operation because we leverage standards, like ANSI, POSIX (Portable Operating System Interface) and standardized networking protocols. It is the use of such standards that makes kludges unnecessary. Industry now uses so many IT architectures, few design software such that is OS or platform specific(*). The rest of the professional software engineering world incorporates standards in software design that IT and OS manufacturers support at the lowest levels in their architectures.

ANSI and POSIX have been around for decades, as have the fundamental network protocols. This is what has ultimately allowed the development of what is popularly called "open source", which for the most part, is comprised of platform and OS independent software. The idea being,

software developers are now freed from needing to know arcane details about operating systems and hardware (open source packages take care of that for you), and can concentrate on making software without having to worry whether or not it will perform on an AIX or on an Apple G5. Protocols, standards, etc. specify standard interfaces to the system kernels regardless of OS and hardware, and the use of open source is one way of ensuring that these standards are leveraged. Not only does it enable the software to be used without modification on any combination of architecture and OS that follows the standards, but it also makes for easy installation as well. This is the primary reason why much software development is being out-sourced. Programmers in New Delhi do not need to know anything about you (except where to send the bill), your systems or LAN architecture. In short you specify the interfaces and the type of processing, and you get back a product that can be used on whatever your systems are.

This is what we do. We leverage open source products that are based on industry standards with minimal effort, such that our systems are a seamless operation. It is also worth stating that industry standards and open source are free of cost. No license fees (you are only required not pass it off as your own product), no fuss, just download and install. This is part and parcel of a modern computing environment. An example of a kludged operations would be where engineers have jury-rigged software that works on one system so it works on or with other systems. In other words, one winds up with the software equivalent of a Rube Goldberg machine. If we appear to be overly sensitive, its because we take great pride in producing a system that works 100% of the time and we would rather not have the adjective kludge applied to our operations. If you're looking for an adjective to describe our operations, "100% availability" would be more preferable.

In my opinion, as a computational scientist with over two decades of experience, both in the private and academic sectors, [redacted] review was a knee jerk reaction to a computing environment with which he was not familiar. However, it is not unfamiliar to those of us who have recent experience in the private sector or at other government labs. What we have is a modern computing environment, not unlike what you would [redacted] Thus we wince anytime someone thinks a recommendation in that document is a good idea even though it contains some suggestions of value. For example, programming tools, like Expect, Tcl/Tk, shell scripts, etc., which [redacted] describes in a somewhat pejorative manner as a "rich mixture" are not kludges. Such tools now serve either as

the backbone of industrial software or as a user interface. Oracle, for example can come in Java (JServer) and Tcl (Oratcl) flavors. The Oracle extensions were developed as open source, with Oracle's blessings and support. Common open source tools use industry standards and can perform tasks with precision and robustness. They can do the thankless task of communicating with the operating system, among many other things. As a result, we spend less time developing software, because these tools greatly simplify the coding and the testing that is required. They also aid in automating our systems and system administration. Writing and debugging a computer program designed to operate a modem is labor intensive. Doing the same thing in Expect takes an hour.

We have been successful in developing a smooth running operation, not because of kludges, but because we leverage industrial standards via open source for our benefit. I believe, and I know the vast majority of other IT professionals would concur this is a strength, not a weakness and as sure as my Mother's love, not a kludge. I can understand your desire to solicit outside "expert" opinions. My co-workers and I are also not without expertise. If you still believe that our systems are "kludged" then please tell us which part of our operation you think is kludged, and we will either explain why it is not a kludge or work hard to remedy the situation.

Thank you for your time.

[redacted]

[redacted]

[redacted] the only exception I can think of, is if one is designing software for a type of supercomputer, such as a parallel processor. However, there now exists open-source for even those kinds of systems (MPICH).

[redacted]