

NUCLEAR TSUNAMI: MYTH OR REALITY? Analysis of the Likelihood Nuclear Bombs to Produce Earthquake and Devastating Tsunami

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DOI: <https://doi.org/10.47814/ijssrr.v9i9.3516>

Abstract

The concept of a "nuclear tsunami" has been discussed in popular media, fiction, and military speculation for decades. It refers to the idea that a nuclear explosion, particularly underwater, could generate a tsunami capable of devastating coastal regions over great distances. This paper examines the physics of tsunami generation, the effects of underwater nuclear detonations, historical nuclear tests, and scientific modeling studies. The analysis shows that while underwater nuclear explosions can produce localized waves and severe damage near the blast site, they are not capable of reliably generating large, ocean-wide tsunamis comparable to those caused by major earthquakes. Consequently, the notion of a "nuclear tsunami" is largely a misconception when considered in the context of transoceanic tsunami hazards.

Keywords: *Nuclear Weapons, Tsunami, Russia, Nuclear Torpedo, International Security, Nuclear Nonproliferation, Fake News, Propaganda, Military Myth*

I. Introduction

Tsunamis are among the most destructive natural hazards on Earth. Most are generated by large submarine earthquakes that displace enormous volumes of seawater. Since the development of nuclear weapons, questions have arisen regarding whether an underwater nuclear explosion could artificially produce a tsunami of similar magnitude.

This paper evaluates the scientific principles governing tsunami formation and compares the energy transfer mechanisms of nuclear detonations and natural geological events.

II. Historic Context

The long lasting dream of Russian's in heaving nuclear torpedo with devastating power.

During the Cold War, there were proposals and speculation about using very large nuclear devices to create devastating waves against coastal targets. These ideas were never demonstrated to be feasible, and scientific analyses have generally concluded that they would not produce the enormous transoceanic tsunamis sometimes imagined. The idea of having super-powerful nuclear torpedo within Russian nuclear arsenal originates from the prominent Russian

nuclear physics Andrei Sakharov¹, who also played a crucial role in building the biggest nuclear bomb ever built - the Tsar Bomba. In particular, Sakharov in his *Memoir*² explains how he came up to the idea of building nuclear torpedo. As Sakharov stressed, after the test of the Big Bomb he was “concerned that the military couldn’t use it without an effective carrier”, because a “bomber would be too easy to shoot down” (Shakarov, 1990, pp.220). Thus, his idea was building giant torpedo that will be launched by a submarine that would be capable of carrying 100-megaton nuclear warhead, which will have strong enough body to withstand the exploding mines, fitted with an atomic-powered jet engine that will enable the torpedo to travel long distances to reach their targets (like harbors), and capable to detonate both in air and underwater.

However, Sakharov gave up on his idea after the conversation that he had with the Rear Admiral Fomin. In the conversation, as he noted, Admiral Fomin told Sakharov that he is “shocked and disgusted by the idea of merciless mass slaughter, and remarked that the officers and sailors of the fleet were accustomed to fighting only armed adversaries, in open battle” (Sakharov, 1990, pp.221). After this conversation, Sakharov hadn’t discussed this idea with anyone else because he considered that it would be foolish wasting “extravagant sums required on research and development work on such torpedoes”, because he feared that this project “couldn’t be kept in secret and contra-measures could easily be devised to detect and destroy the torpedoes enrooted to their targets”³ (Sakharov, 1990, pp.221).

III-1. What we know about the “recent version” of Russian nuclear torpedo?

In March 2018, during his annual State of the Union address⁴, the Russian President Vladimir Putin revealed that 300 new models of weaponry, including 18 new ICBMs, 2 submarine-based ballistic missiles and underwater drones, with main purpose to increase the defense and deterrence capabilities of the Russian Federation in the forthcoming years. Some experts familiar with the intelligence assessments in the U.S stressed that Russian motives is to develop an underwater drone armed with nuclear warhead “as a retaliation device if their legacy nuclear weapon launch capability is neutralized during war.”⁵

The Poseidon program was first introduced to the world back in 2015, as a result of in state TV 'leak', initially known as a long-range nuclear torpedo - called "Status-6".⁶ According to that document, the secret oceanic multi-purpose Status-6 system is designed to "destroy important economic installations of the enemy in coastal areas and cause guaranteed devastating damage to the country's territory by creating wide areas of radioactive contamination, rendering them unusable for military, economic or other activity for a long time".⁷ Due to the public pressure as a result to this leak, the Russian government newspaper Rossiiskaya Gazeta later reported external details of the weapon describing it as a super-radioactive cobalt device.⁸ Furthermore, in their publication, the Rossiiskaya Gazeta stressed out that this giant torpedo with a thermonuclear munition, whereas the last shell contains cobalt-59 and not uranium-238, has a range of 10 thousand kilometers, a depth of a kilometer and a speed of 100 knots, capable to calmly pass all sonar tracking stations and other traps.⁹ According to certain nuclear scientists, Cobalt-60 (60Co) is “a synthetic radioactive isotope of cobalt with a half-life of 5.2714 years”¹⁰, and it can be “produced artificially in nuclear reactors through neutron

¹ Sakharov, A., Important Scientists https://www.physicsoftheuniverse.com/scientists_sakharov.html

² Sakharov, A. (1990), *Memoirs*, N.Y. : Alfred A. Knopf, English, <https://archive.org/details/memoirs00sakh>

³ Among other reasons, because radioactive contamination of the ocean would be inevitable.

⁴ Vladimir Putin, (2018), *Putin reveals new Russian missile that can 'reach any point in the world'*, <https://www.cnbc.com/2018/03/01/putin-new-russia-missile-nuclear.html>

⁵ Macias ,Amanda, (2019), CNBS, Russia’s nuclear-armed underwater drone, <https://www.cnbc.com/2019/03/25/russias-nuclear-armed-underwater-drone-may-be-ready-for-war-in-2027.html>

⁶ BBC, (2015), *Russia reveals giant nuclear torpedo in state TV 'leak'*, <https://www.bbc.com/news/world-europe-34797252>

⁷ Ibid.

⁸ Valagin, A. (2015), *Russia "exposed" a new superweapon*, <https://www.rg.ru/2015/11/12/bomb-site.html>

⁹ Ibid.

¹⁰ Eckerman, K.; Endo, A. (2008). Annex A. Radionuclides of the ICRP-07 collection. ICRP Publication 107. Vol. 38. International Commission on Radiological Protection. pp. 35–96.

activation of Co-59”¹¹. The detonation of such bomb would cause destruction of the Earth’s biosphere, and according to public data, no country has ever built.

What is indicative is that, as part of the Russian disinformation campaign, Rossiiskaya Gazeta was referencing a prominent American nuclear scientist Leo Szilard who discussed about the possible development of other doomsday devices to destroy the human life on Earth. Therefore, he does not propose the development of such bomb, but his statement is a warning that with the development of new nuclear technology such scenario could happen in future.^{12 13} **Thus, Russia through its government newspaper tried to justify its actions based on a false claims against United States.** There is no public data that the United States of America has tested such bomb, although the U.K did certain testing of cobalt bombs in September 1957, which was considered unsuccessful and it was not repeated ever.¹⁴

The 2018 Nuclear Posture Review of the United States defines “Poseidon” as an “intercontinental, nuclear-armed, nuclear-powered, undersea autonomous torpedo”.¹⁵

Another weaponry that was inaugurated by the Russia’s President Vladimir Putin is the nuclear-powered submarine Belgorod – a 600 feet (184m) long which serves as a launch platform for Russia’s nuclear-armed Poseidon underwater unmanned vehicles (UUVs)¹⁶. Hence, the introduction of new nuclear weaponry in the Russian arsenal raises the concerns of new nuclear armament race among the biggest nuclear weapon states – the United States and Russia.

III. Effects of Detonating Nuclear Bomb

The extent of damage as well as the output from detonating a nuclear bomb depends on the type of burst (explosion), environment and meteorological conditions, such as temperature, humidity, wind, precipitation and atmospheric pressure are (S.Glasston & P.J. Dolan, 1977, pp.35).

In overall, all nuclear blasts are known to cause the following effects:¹⁷

1. **A flash of light.**
2. **A pulse of thermal (i.e., heat) energy.**
3. **A pulse of nuclear radiation.**
4. **A fireball.**
5. An air blast (shock wave)
6. Radioactive fallout

In this regard, the flash of light, pulse of thermal energy and pulse of nuclear radiation are happening instantaneously, and they travel at a light speed. However, the extent of thermal radiation depends on the nature and yield of the weapon, and particularly on the environment of the explosion.¹⁸

¹¹ Malkoske, G. R.; Slack, J.; Norton, J. L. (2–5 June 2002). Cobalt-60 production in CANDU power reactors. 40 years of nuclear energy in Canada = 40 années d’énergie nucléaire au Canada (Conference). Vol. 34. Canadian Nuclear Society. pp. 96Megabytes. ISBN 978-0919784697.

¹² Clegg, Brian (2012-12-11). Armageddon Science: The Science of Mass Destruction. St. Martins Griffin. p. 77. ISBN 978-1-250-01649-2.

¹³ Bhushan, K.; G. Katyal (2002). Nuclear, Biological, and Chemical Warfare. India: APH Publishing. pp. 75–77. ISBN 978-81-7648-312-4.

¹⁴ Cobalt Bombs and other Salted Bombs <https://nuclearweaponarchive.org/Nwfaq/Nfaq1.html#nfaq1.6>

¹⁵ 2018 Nuclear Posture Review, page.9, <https://media.defense.gov/2020/May/18/2002302062/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF>

¹⁶ Shaan Shaikh, "Russia Launches New Nuclear Submarine," Missile Threat, Center for Strategic and International Studies, April 26, 2019, last modified April 26, 2019, <https://missilethreat.csis.org/russia-launches-new-nuclear-submarine/>.

¹⁷ Guenot, M., If a nuclear weapon is about to explode, here are 17 things you can do, Business Insider, <https://www.businessinsider.com/survive-nuclear-explosion-go-inside-shelter-no-windows-2018-1>

Therefore, regardless of the height of burst, approximately 85 percent of the explosive energy of nuclear fission weapon produces air blast (pressure and shock waves), thermal radiation and heat; 5 percent are consisted of the initial nuclear radiation released/produced in seconds or minutes of the detonation; whereas the last 10 percent is total fission energy [or delayed nuclear radiation] emitted over a period of time. Worth mentioning is that, the delayed nuclear radiation occurs mainly from the fission products that “in the course of their radioactive decay, emit gamma rays and another type of nuclear radiation called “beta particles” (S.Glasston & P.J. Dolan, 1977, pp.17).^{19 20}

The betta particles have a considerable less penetrating power compared to a gamma rays, but they are still highly hazardous for the human beings. As previously said, the immediate effects and the output of detonation of nuclear bomb vary on the location of the point of burst related to the surface of the earth.

Hence, the study entitled as “Effects of Nuclear Weapons,” conducted for the purposes of the Department of Defense (DoD) and Department of Energy (DoE) of the United States, identifies 5 types of burst (explosion):²¹

- Air burst
- High-altitude burst
- Underwater burst
- Underground burst
- Surface burst

For the purposes of this article, we will focus only on the **underwater bursts (explosions)**.

In terms of **underwater bursts**, the extent of damage depends whether that occurs in shallow water or deep water. In an event of nuclear blast underwater, all the thermal energy that has been released from the fireball, as well as the neutrons, beta particles and gamma rays released within a short period of time from the explosion, will be absorbed by the surrounding water. Thus, once the fireball reaches the sea surface, the beta particles and the gamma rays will play as some sort of initial radiation. Hence, the water fallout from the explosion will be very radioactive, especially if the detonation occurs in the shallow water “could suck up tons of ocean sediment, irradiate it, and rain it upon nearby areas”.²²

In short, the biggest threat from the underwater explosion will be the radioactive fallout, that is considerably less powerful compared with those occurred from air blast, but not the tsunami-type waves.

IV. Earthquakes and Tsunamis

The main questions that are subject for analysis of this article are: what is the likelihood for a nuclear bomb to produce earthquake, and, can a nuclear bomb generate devastating tsunami waves as Russians argue? There is a myth and fear spread among people that deep underground nuclear bombs can generate natural earthquakes. In addition to this article I will elaborate more on how likely a nuclear bomb can produce earthquakes and/or tsunamis.

¹⁸ <https://apps.dtic.mil/dtic/tr/fulltext/u2/a087568.pdf>

¹⁹ Glaser, A. (2007), Effects of Nuclear Weapons, Princeton University, pg.17,
https://www.princeton.edu/~aglaser/lecture2007_weaponeffects.pdf

²⁰ Brode, H. (1963), Thermal Radiation from Nuclear Explosion, RAND,
<https://www.rand.org/content/dam/rand/pubs/papers/2008/P2745.pdf>

²¹ <https://apps.dtic.mil/dtic/tr/fulltext/u2/a087568.pdf>

²² McGrath, C., (2018), WW3: Putin’s doomsday nuclear-armed drone sub ‘could trigger 300ft tsunami to WIPE OUT LA’
<https://www.express.co.uk/news/world/1063847/WW3-putin-doomsday-nuclear-armed-drone-submarine-tsunami-hypersonic-weapons-world-war-3>

During BENHAM test when a 1.1 megaton nuclear device was detonated at the Nevada Testing Site, the following was noticed related to the ground shocks (S.Glasston & P.J. Dolan, 1977, pp.238-241):²³ *“In a fully-contained deep underground explosions there would be little or no air blast...Much of the energy is expended in forming the cavity around the burst point and melting the rock, and the remainder appears in the form of a ground shock wave...As this shock wave moves outwards it first produces a zone of crushed and compressed rock, somewhat similar to the rupture zone associated with crater formation... Finally, at considerable distances from the burst point, the weak shock wave (carrying less than 5 percent of explosion energy), becomes leading wave of a series of seismic waves...”*

A seismic wave produces a temporary 62 (elastic) displacements or disturbance of the ground – typical of earthquake motion...”

According to the same study, the BENHAM test took place on a focal depth ranging from 0.6 to 3 miles, but not exceeding 4 miles, which is 3 times lesser than the minimum 12 miles focal point depths for almost all natural earthquakes that have occurred in the testing area. Additionally, during this test a “maximum vertical displacement was 1.5 feet (or 0.45m), at location 1.5 and 2.5 miles north of the explosion point”. Besides that, the MILROW nuclear device with yield lesser than 1megaton (October,1969) tested at a depth of 4,000 feet (1,200m), as well as the CANNIKIN test for nuclear weapon with yield lesser than 5 megaton (November,1971) tested at a depth of 5,875 feet (1,790m) bellow the Amchitka Island proved that **“there was no evidence of any increase in the frequency of such earthquakes in the sensitive Aleutian Islands region following the MILROW and CANNIKIN”** nuclear test events. (Ibid,p.241).Note, it is believed that earthquakes are occurring in a depth ranging from 20km up to 700km.²⁴ Also, it takes an earthquake with a Richter magnitude exceeding 7.5 to produce a destructive tsunami.²⁵

Last but not least, both Russia and the United States have nuclear torpedoes in their arsenal. In particular, U.S has developed the Mark 45 with yield of around 11 kT²⁶, whereas and Russians have developed the T-15 with yield of around 4 kT²⁷. In the period from April to November 1962, the United States have exercised a top-secret operation code-named as “DOMINIC - I”²⁸, during which 36 nuclear tests were conducted with a nearly total yield of 38.1 Mt.²⁹ As a part of the operation “DOMINIC I”, on 11 May 1962, the United States Navy conducted the ASROC weapon system and weapon effects test, a rocket-launched antisubmarine nuclear depth charge (ASROC) capable of carrying around 10kt nuclear warhead.³⁰ The ASROC test known as Operation “Swordfish,” was detonated at a depth of 650 feet.³¹

²³S.Glasston & P.J. Dolan, 1977, The effects of nuclear weapons, pg.238-241,

<https://www.atomicarchive.com/resources/documents/effects/glasstone-dolan/>

²⁴ United States Geological Survey, At what depth do earthquakes occur? What is the significance of the depth?, https://www.usgs.gov/faqs/what-depth-do-earthquakes-occur-what-significance-depth?qt-news_science_products=0#qt-news_science_products

²⁵ International Tsunami Information Center, https://legacy.itic.ioc-unesco.org/legacy.itic.ioc-unesco.org/index89f2.html?option=com_content&view=article&id=1158:how-do-earthquakes-generate-tsunamis&catid=1340&Itemid=2060#:~:text=Usually%2C%20it%20takes%20an%20earthquake%20with%20a%20Richter,Pacific%20along%20its%20Ring%20of%20Fire%20subduction%20zones.

²⁶ Complete List of U.S Nuclear weapons, Mark 45, <https://nuclearweaponarchive.org/Usa/Weapons/Allbombs.html>

²⁷ Global Security <https://www.globalsecurity.org/wmd/world/russia/t-15.htm>

²⁸ U.S Department of Defense, https://www.dtra.mil/Portals/61/Documents/NTPR/1-Fact_Sheets/24_DOMINIC_II.pdf, <https://archive.org/details/OperationDOMINICNuclearTests1962#:~:text=This%20Dominic%20I%20video%20provides%20a%20usual%20overview,nuclear%20test%20series%20conducted%20by%20the%20United%20States.>

²⁹ Yang,X, North,R, Romney,C and Richards,P, Worldwide Nuclear Explosions, https://www.ldeo.columbia.edu/~richards/my_papers/WW_nuclear_tests_IASPEI_HB.pdf

³⁰ U.S Department of Defense, https://www.dtra.mil/Portals/61/Documents/NTPR/2-Hist_Rpt_Atm/1962_DNA_6040F.pdf ; U.S NAVY <https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2169310/vertical-launch-anti-submarine-rocket-asroc-vla-missile/>

³¹ 1962 ASROC Navy Nuclear Tests, <https://archive.org/details/1962PacificNuclearTests>; https://www.youtube.com/watch?v=EV5q_mlhaiM

During this operation, the following was noticed:³²

- Spray dome stretched in a radius of 1,000 yards from surface-zero and rose up to 750 feet (228.6m);
- Radial plumes of water broke from the spray dome 7 seconds after the burst, and have reached a height of 2,100 feet (640.08m) within 16 seconds;
- As the plumes collapsed, a base surge was formed, by reaching maximum upwind distance of 2,000 yards 140 seconds after burst;
- As the base surge dispersed, a foam patch appeared about 20 minutes after the burst.

The test was successfully accomplished and proved the foreseen results - “grave danger” for the enemy’s submarines. Although this weapon was intended for destroying enemy’s submarines, they still pose a great destructive power, but it is insufficient to create/produce tsunami waves.

V. Analysis of the Effects.

The 2011 Tohoku earthquake registered near East coast of Honshu (Japan) with magnitude of 9.1 has caused a tsunami with devastating power.^{33 34} The aftermath of the 2011 Tohoku earthquake and tsunami was: 15,821 deaths, 3,962 missing, 5,940 injuries, more than 350,000 refugees, three nuclear reactors meltdown in Fukushima.³⁵ Tsunami waves have reached the United States, Alaska, Hawaii, Chile, Norway and Antarctica.³⁶

At the beginning, we will provide an illustration of the power of each magnitude of earthquake to produce energy, expressed in joules. As can be seen, each magnitude of earthquake have a different power of releasing energy, and goes as the following:³⁷

Richter Magnitude	TNT for Seismic Energy Yield	
-1.5	6	ounces
1.0	30	pounds
1.5	320	pounds
2.0	1	ton
2.5	4.6	tons
3.0	29	tons
3.5	73	tons

³² Operation Dominic, (1962), U.S Defense Nuclear Agency, <https://www.osti.gov/opennet/servlets/purl/16389215.pdf>

³³United States Geological Survey, (2011), M 9.1 - 2011 Great Tohoku Earthquake, Japan (2011), https://earthquake.usgs.gov/earthquakes/eventpage/official20110311054624120_30/executive

³⁴ U.S Tsunami Warning System, (2011), <https://www.tsunami.gov/?page=tsunamiFAQ>

³⁵ Dunbar.P et all, (2011), 2011 Tohoku earthquake and tsunami data available from the National Oceanic and Atmospheric Administration, pg 305-323, <https://www.tandfonline.com/doi/full/10.1080/19475705.2011.632443#d1e325>

³⁶Japan earthquake & tsunami of 2011: Facts and information, Live Science, <https://www.livescience.com/39110-japan-2011-earthquake-tsunami-facts.html>

³⁷ Richter Scale presented by TNT explosions, https://cdn.citl.illinois.edu/courses/KINES401/Lesson1_lectures/Lecture1_P3/web_data/file9.htm

4.0	1,000	tons	
4.5	5,100	tons	
5.0	32,000	tons	
5.5	80,000	tons	
6.0	1 million	tons	
6.5	5 million	tons	
7.0	32 million	tons	
7.5	160 million	tons	
8.0	1 billion	tons	
8.5	5 billion	tons	
9.0	32 billion	tons (32,000,000,000kg of TNT=	133,888,000,000,000,000jouls)
10.0	1 trillion	tons	
12.0	160 trillion	tons	

Some additional information's, for the purposes of this debunk:

One ton = 1,000 kg.

One kiloton = 1,000t of TNT or 1,000,000 kg of TNT.

One megaton = 1,000,000t of TNT or 1,000,000,000 kg of TNT.

1 foot = 0.3048 meters.

Hence, If we calculate the energy³⁸ that can be released from a **detonation of a bomb and the Tohoku earthquake** we will get the following results:

- One megaton is equivalent to 1,000,000,000kg of TNT and is capable of releasing 4,184,000,000,000,000 (4.184 x 10¹⁵) joules of energy, whereas the nuclear bomb of 2Mts is equivalent to 2,000,000,000 kg of TNT, and is capable of producing 8,368,000,000,000,000 (8.368 x 10¹⁵) joules of energy.

- For a very large earthquakes, like Tohoku 2011 was, the moment magnitude (Mw) is the most reliable estimate of the earthquake size, related to the total energy released during the earthquake.³⁹ After that, by using a standard formula, the Mw is then converted into a number similar to other earthquake magnitudes. According to the standard formula, the power of an earthquake of a 9.0 magnitude is equivalent to 32,000,000,000kg of TNT, and is capable of releasing 133,888,000,000,000,000 joules (1,338 x 10¹⁷). Hence, according to the standard formula, the earthquake of 9.0 magnitude has a power equivalent of a 32 Mt thermonuclear bomb, or compared, the 2Mts bomb is 16.6 times weaker than the earthquake with magnitude of 9.0 by Richter scale.

However, according to the U.S Geological Survey's momentum tensor, the 2011 Tohoku earthquake registered near East coast of Honshu (Japan) was of magnitude 9.1, which released energy equivalent to 9.3 million megatons of TNT energy that created a devastating tsunami.^{40 41} So, if we calculate the energy that can be released from a **detonation of a 2Mt bomb and the Tohoku tsunami** we will get the following results:

³⁸ Convert megaton to joule - Conversion of Measurement Units, <https://www.convertunits.com/from/megaton/to/joule>

³⁹ Moment Magnitude, Richter Scale, https://www.usgs.gov/faqs/moment-magnitude-richter-scale-what-are-different-magnitude-scales-and-why-are-there-so-many?qt-news_science_products=0#qt-news_science_products

⁴⁰ United States Geological Survey, (2011), M 9.1 - 2011 Great Tohoku Earthquake, Japan https://earthquake.usgs.gov/earthquakes/eventpage/official20110311054624120_30/executive

⁴¹ United States Geological Survey, (2011), Earthquake Hazard Program - USGS WPhase Moment Solution, https://web.archive.org/web/20160820195121/http://earthquake.usgs.gov/earthquakes/eqinthenews/2011/usc0001xgp/neic_c0001xgp_wmt.php

- **9.3 million megatons of TNT are equivalent to 9,300,000,000,000,000 kg of TNT, or 9,300,000 Mts of TNT. Interpreted in joules of energy, it is equivalent of 38,911,200,000,000,000,000 or 3.891×10^{22} joules of energy.**
- Finally, the 2Mt bomb is 4.6×10^6 times (4,6 million) weaker than the 2011 Tohoku earthquake that caused devastating tsunami waves.

Even the biggest nuclear bomb ever tested, the Soviet-made Tsar Bomba of 58Mt (tested on 30 October 1961)⁴², that is capable of releasing about 2,42,672,000,000,000,000 (2.4×10^{17}) joules of energy, is nearly 1.62×10^5 times (162,000) weaker than the 2011 Tohoku tsunami.

So the question that here arise is, why the 2011 Tohoku tsunami was that powerful? All of these effects depends of the time and location where this occurs. The Tohoku earthquake occurred below the sea floor near the coast on a depth of about 29 km⁴³, lasted for 6 minutes caused by the collapse of the two tectonic plates on which Honshu Island lies on⁴⁴, by releasing tremendous quantity of energy that have produced shock and killer waves, in a height ranging from several feet up to 33 feet⁴⁵, 40 feet⁴⁶ and 132 feet.⁴⁷ Furthermore, the devastating earthquake started with foreshocks on March 09 with magnitude of 7.4, at a distance of 40kms away from the epicenter occurred on the 11 March 2011 that is believed to had an impact on the intensity of the one occurred on the 11 March 2011.⁴⁸

According to the estimates of the Wisconsin Project on Nuclear Arms Control⁴⁹, the nuclear chain reaction (or series of nuclear fissions – splitting the atomic nuclei) occurs in a 0.07 microseconds. But, the complete process of bomb explosion occurs in a moment lesser than a microsecond according to the following estimate:⁵⁰

A critical mass of uranium is about the size of a softball (0.1 meters).

The time the neutron would take to cross the sphere is:

$$Time = .1seconds / (1 \times 10^7 meters / second)$$

OR

$$Time = 1 \times 10^{-8} seconds$$

$$Time = 1 \times 10^{-8} seconds$$

The complete process of a bomb explosion is about 80 times this number, or ***slightly less than a microsecond or .0000008 seconds.***

⁴² Tsar Bomba, <https://www.army-technology.com/features/featurethe-biggest-and-most-powerful-nuclear-weapons-ever-built-4206787/?cf-view>

⁴³ P.Dunbar, H. McCullough, G. Mungov, J.Varner & K. Stroker,(2011), 2011 Tohoku earthquake and tsunami data available from the National Oceanic and Atmospheric Administration/National Geophysical Data Center ‘’, Taylor & Francis, Volume 2, Issue 4, <https://doi.org/10.1080/19475705.2011.632443>

⁴⁴ The Geological Society, (2011), Plate Tectonic Stories Tohoku Earthquake, Japan <https://www.geolsoc.org.uk/science-and-policy/plate-tectonic-stories/tohoku-earthquake/>

⁴⁵ Japan Tsunami: Wave Heights – March 11, 2011, <https://sos.noaa.gov/catalog/datasets/japan-tsunami-wave-heights-march-11-2011/>

⁴⁶ New York Times, (2011), Sea Walls Offered Little Protection, <https://www.nytimes.com/2011/03/14/world/asia/14seawalls.html>

⁴⁷ National Geographic, Mar 11, 2011 CE: Tohoku Earthquake and Tsunami, <https://education.nationalgeographic.org/resource/tohoku-earthquake-and-tsunami/>

⁴⁸ United States Geological Survey, (2011), M 9.1 - 2011 Great Tohoku Earthquake, Japan, https://earthquake.usgs.gov/earthquakes/eventpage/official20110311054624120_30/executive

⁴⁹ Wisconsin Project on Nuclear Arms Control, Nuclear Weapons Primer <https://www.wisconsinproject.org/nuclear-weapons/>

⁵⁰ How long does a nuclear explosion take, <https://www.quora.com/How-long-does-a-nuclear-explosion-take>

Summary of results:

	Yield/magnitude	Temperature	Depth	Height of waves	Duration
Earthquake (2011 Tohoku)	9.1 magnitude	$3,891 \times 10^{22}$ joules Lasted longer, thus, has released tremendous energy. As longer in duration, the more energy is released.	29 km	From 10 up to 40m in height	Lasted longer, thus, releasing tremendous energy. Slightly more than 6 minutes
Earthquake	9.0 magnitude	$1,34 \times 10^{17}$ joules	20km – 700 km	seismic waves	From several seconds to several minutes
Nuclear Bomb	58Mt	2.43×10^{17} joules	Air, surface	N/A	Detonation occurs in less than one microsecond
Poseidon	Up to 2Mt	$4,6 \times 10^6$ joules	1,000 m	Possibly can induce waves, but not exceeding the normal height of the waves (2-3m), contaminate the water with radioactive materials	The nuclear warhead detonation occurs in less than one microsecond

VII. Conclusion

In sum, the nuclear tsunami is a least like to occur! In a hypothetical scenario, Russia would need to detonate hundreds or thousands of bombs of certain yield, at the same time and the same place, in order to achieve the desired effect like that in Japan. This scenario is least likely to occur either.

Nonetheless, the nuclear drone in a form of gigantic torpedo would be a great danger for the adversary's army harbors and submarines due to the ability to pierce deeply into their territory or to approach to its submarines without being detected. Depending on the yield of the nuclear warhead, even if the nuclear drone-torpedo explodes on a certain distance from the submarines, they still can cause serious damages on the enemy's submarines and contaminate the water from the radioactive fallout which could be danger for the people and the environment. Lastly, up to date, there is no evidence that a cobalt bomb was ever built nor that nuclear torpedo can cause tsunami's like Tohoku in Japan back in 2011.

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