Damage Review

Tabulation of all hits

The projectiles that caused each Hit as estimated in this essay:

Hit 1 – 6-inch Type 0 HE or Type 4 base-fuzed Common projectile
Hit 2 – 14-inch Type 0 HE projectile
Hit 3 – 6-inch Type 0 HE or 5.5-inch Type 2 HE projectile
Hit 4 – 8-inch Type 91 AP projectile
Hit 5 – 8-inch Type 0 HE projectile
Hit 6 – 8-inch Type 91 AP projectile
Hit 7 – 5.5-inch base-fuzed Common projectile
Hit 8 – 5.5-inch base-fuzed Common projectile
Hit 9 – 8-inch Type 91 AP projectile
Hit 10 – 8-inch Type 91 AP projectile
Hit 11 – 14-inch Type 0 HE projectile
Hit 12 – 5.5-inch base-fuzed Common projectile
Hit 13 – 6-inch Type 4 base-fuzed Common projectile
Hit 14 – 6-inch Type 4 base-fuzed Common projectile
Hit 15 – 14-inch Type 3 Incendiary AA projectile
Hit 16 – 6-inch Type 4 base-fuzed Common projectile
Hit 17 – 8-inch Type 91 AP projectile
Hit 18 – 6-inch Type 4 base-fuzed Common projectile
Hit 19 – 5.5-inch base-fuzed Common projectile or 6-inch Type 4 Common projectile
Hit 20 – 6-inch Type 4 base fuze Common projectile
Hit 21 – 14-inch Type 1 AP cap head and windscreen
Hit 22 – 5-inch Type 0 HE projectile
Hit 23 – 14-inch Type 3 Incendiary AA projectile
Hit 24 – 6-inch Type 0 HE projectile
Hit 25 – 8-inch Type 91 AP projectile
Hit 26 – 14-inch Type 1 AP projectile
Hit 27 – 5-inch Type 0 HE projectile or fragment damage

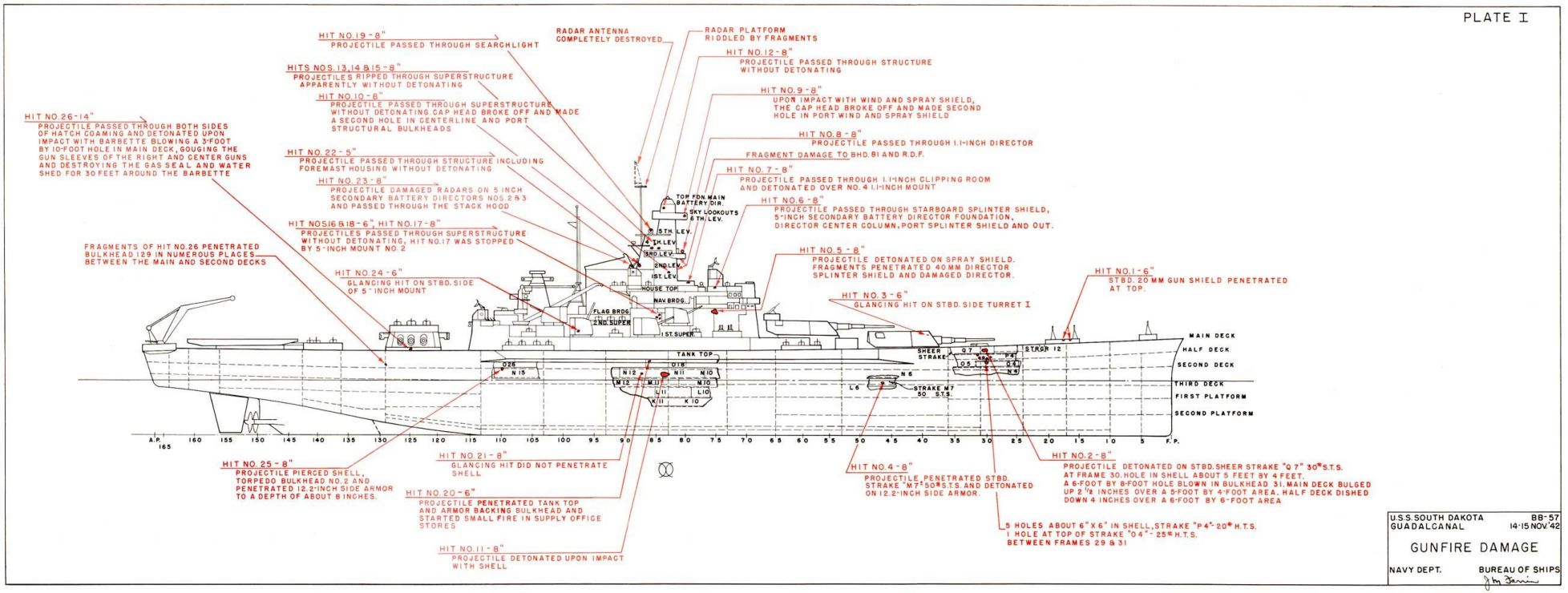
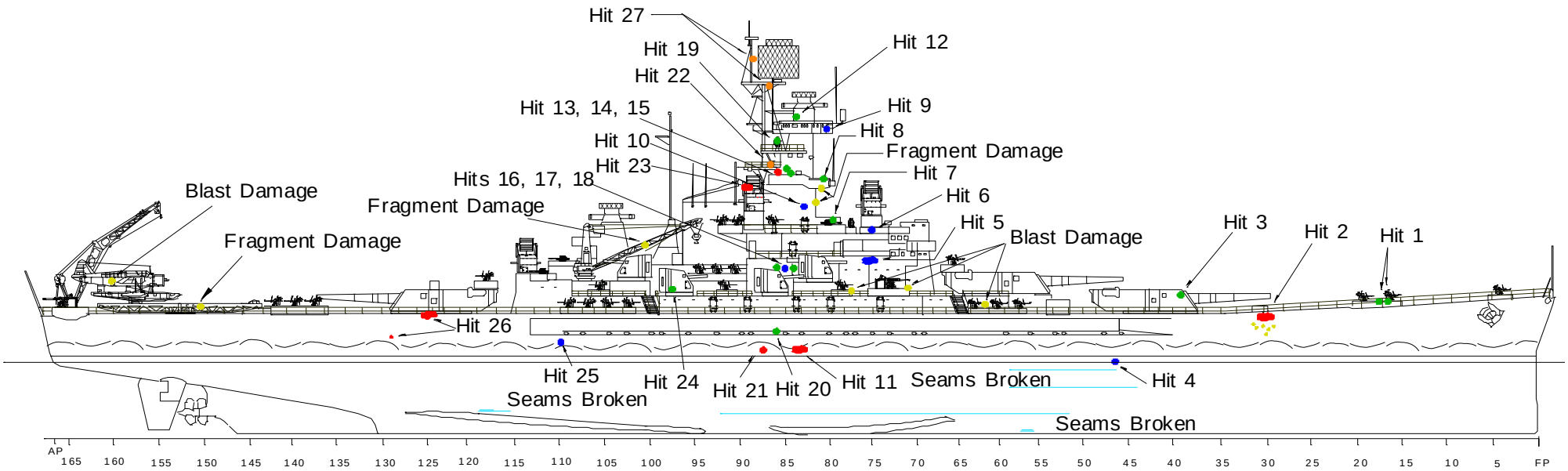


Figure 118 – Hits on *South Dakota* as estimated by BuShips
Plate 1 from BuShips War Damage Report #57



14-inch projectile

8-inch projectile

5.5-inch to 6-inch projectile

5-inch projectile

Blast or Fragment damage

Seam damage to hull

Figure 119 – Hits on *South Dakota* as estimated by Lundgren and Okun
Numbering of Hits per BuShips War Damage Report #57

Performance of Japanese Shells

Both the BuShips' report and the *South Dakota*'s action report mention that many Japanese shells failed to properly detonate and thus the ship escaped more serious damage.

In reviewing all of the hits described in this essay, the authors found that the following ones did not have high-order detonations: Hits 1, 6, 8, 9, 10, 12, 13, 14, 15, 17, 19, 21 and 23.

Of these, Hits 15 and 23 were by 14-inch Type 3 Incendiary AA projectiles that broke apart and should not really be considered as duds. Hit 21 was made only by a cap head, so no explosive filler was involved and thus no possible detonation. Hits 1, 8, 9 and 19 were most likely from base-fuzed projectiles that did not hit anything thick enough or with significant mass to slow the projectile down or even activate the fuze.

Hit 6 and 10 were by 8-inch AP shells where their long fuze delay prevented detonation while they were still within the ship's structure. This sort of lack-luster performance was quite common in other actions where the Japanese used AP projectiles with long fuze delays.

Hits 12, 13 and 14 were from 5.5-inch and 6-inch shells that were duds, possibly due to mercury fulminate decay in storage as reported by the post-war US Naval Technical Mission.[111]

Hits 4 and 25 produced low-order detonations. These both struck the main belt and probably both suffered from shatter, which may be the reason why they did not explode properly.

The one hit that failed to detonate that is hardest to explain is Hit 17, which was the 8-inch shell that the crew found on deck after the battle. This shell should have detonated given what it hit as it passed through the ship. In reviewing this hit, the authors have re-examined Japanese methodology for testing their shells and fuzes. It would appear that the very long (0.4-second) delay elements in Japanese Type 91/1 AP projectiles were not resistant to being slammed around sideways due to high projectile yaw, since the shells were only tested at 20 degrees obliquity against single 2/3rds-caliber thick face-hardened plate for their larger caliber shells, and against roughly the same thickness of homogeneous armor for their 6.1-inch and 8-inch caliber shells. In the case of the 6.1-inch and 8-inch Type 91 AP shells, the Japanese also tested them for hits up to 45 degrees obliquity, but only against rather thin, single homogeneous armor plates. This means that they did not think to test their designs for multiple impacts against thin plates. If you do not test for something, then you can be fairly sure that if that something happens that there is probably going to be a high chance of failure – in this case the brittle black powder pellet being subject to high sideways shock forces again and again in quick succession from all sides as the highly yawed shell hits several plates one after the other at different sideways angles (up-down, left-right, tilted in-between as the shell nose nutates) during the time that the pellet is burning down. This is one possible reason that the 8-inch Type 91 AP shell fuze in Hit 17 did not go off. The other possible reason is that the plates that the shell struck were just not thick enough to set off the fuze and by the time the shell hit the plate on the back of the port-side 5-inch twin gun mount, which was thick enough, the projectile was moving so slowly that even that impact shock was too weak to activate the fuze. This might especially be the case as the shell was so highly yawed that the impact force on the firing pin was not down the shell's centerline but as much sideways as lengthwise, thus jamming the firing pin (like those US torpedo firing pins that didn't work right).

[111] U.S. Naval Technical Mission to Japan Report O-17 Japanese Projectile Fuzes

This may be true for other dud shells 8-inches and up, as some of these hits on *South Dakota* were against plate too thin to reliably set off the base fuze and the black powder delay was perhaps not always reliable when knocked around by more than one plate hit (even thin plates) while burning.

The US Mark 21 base fuze used the primer explosion to jam the entire mechanism into a locked position during the rest of the 0.033-second delay, due to these heavy forces during oblique impact, but this would also work against hitting spaced plates. This was almost certainly due to failures with previous base fuzes when tested under more realistic conditions (higher obliquity, thicker plates, and/or multiple impacts during the delay time).

The following hits did detonate: Hits 2, 3, 4, 5, 7, 11, 16, 18, 20, 22, 24, 25, 26, and 27. Of these, the following were definitely high order detonations: Hits 2, 3, 5, 7, 11, 16, 18, 20, 22, 24, 26 and 27. However, only Hits 2, 5, 11 and 26 were by large-caliber shells. All of the rest were from 6-inch or smaller-caliber projectiles. Hits 2, 5 and 26 are very noticeable as having struck above deck or very close to the main deck. Hit 11, being close to waterline, was probably not as noticeable. When the BuShips' report notes that they found three high order detonation hits, we would believe that they counted Hits 2, 5 and 26. These are also the ones that produced the largest holes in the ship.

Summary

Robert Lundgren:

The story of *South Dakota*'s battle damage developed like a murder mystery as we found new information on just how the battle actually happened. As we stitched together more information concerning *Kirishima* and discovered that she had opened fire long before the heavy cruisers and that Japanese records show that she had hit on her first salvo in *South Dakota*'s superstructure, with multiple men all observing the same event from various ships, I started to wonder what they actually saw and could it be true.

For example, Admiral Lee saw *South Dakota* being hit and sent messages asking her if she was OK at 0049, which was one minute after the Japanese light cruisers opened fire. He witnessed her veering south at 0054, so he was fully aware that she was taking fire long before *Washington* opened fire at 0100. This is important in that it tells us that the times listed in *South Dakota*'s report are accurate. But, if these are accurate, then a question formed as to how the BuShips report in 1947 could be accurate in stating that her Radar Plot was ripped by 8-inch shells as that damage was inflicted at a time before any 8-inch shells were ever fired. Having found this discrepancy, then the next question was; were there other inaccuracies in the BuShips report? The more I rummaged through this report, the ship's own concurrent damage reports and the Japanese reports, the more it seemed that the conclusions in the BuShips' report could no longer be taken for granted. I found that I needed to gather up all the clues and put them in some sort of order so that a new analysis of *South Dakota*'s damage could be created.

My major contribution for this essay was in finding this new information and finding the inconsistencies among the various documents. However, it is Nathan Okun who provided the expertise to determine the type of shells that may have caused the damage. As Nathan works for NAVSEA (though this historical study is not related to his job there), which at one time was BuShips, it is fitting that he participate in this re-examination of *South Dakota*'s battle damage.

The physical evaluation of her damage as described in this essay now confirms what the Japanese witnessed and reported this night. Documentation from both United States and Japanese sources can now be seen to support each other so that when placed together this battle can now be placed into context as it has never been done before.

Overall, the *South Dakota* class battleships were tough ships. Their internal armor arrangement meant that Japanese AP shells faced a complex set of defenses that would typically remove their nose ballistic and AP caps before they struck the armor plates. The side shell of these ships was strong enough to limit the damage of even the largest Japanese HE caliber shells fired at point blank range. At Guadalcanal, the "All-or-Nothing" armor system worked as her designers intended in limiting structural damage and keeping the ship's fighting capacities intact.

USS *South Dakota* was hit by 26 or possibly 27 shells when we add the shell making a direct hit on the Radar platform (Hit 27). Between the cruisers, destroyers and *Kirishima*'s secondary battery, the Japanese hit an estimated 13 to 14 times with 5-inch to 6-inch shells. The heavy cruisers *Atago* and *Taka*o between them contributed at least seven 8-inch shell hits. *Kirishima* added another six hits from her main battery. Considering that *Kirishima* may have suffered as many as twenty 16-inch hits in a five to seven minute time span,[112] losing 50% of her main battery from gunfire and associated destruction, she

[112] See The Battleship Action 14-15 November 1942

did well to score this many hits. However, the performance of *South Dakota*'s armor shows just how well she was designed and built to survive damage even when involved in a night fight at point blank range.

In a larger context, the importance of this battle should not be underestimated in any study of US Naval History. Japan chose war instead of a diplomatic solution primarily based upon the belief that her military forces could decisively defeat the US Navy in a short, limited war. The Japanese believed that this defeat would shock the US public into accepting the Japanese gains from this war and that they would not want to face an extended campaign to win back captured territories. The Japanese Government knew prior to hostilities that a long war with the US and its vast industrial power could not be won and they understood that it was imperative that Japan win quickly before the US industrial capacity could take effect. Unfortunately, when the time came to finish the US fleet in November 1942, Admiral Yamamoto failed to understand just how limited were the US resources at that moment. His November offensive was poorly planned and failed to take advantage of the Japanese superior numbers in ships at a time when his US counterpart Admiral Halsey was committing his last three capital ships (USS *Enterprise,* USS *Washington* and USS *South Dakota*) to battle in order to hold Guadalcanal.[113] After the battles of 12 to 15 November 1942 where the battleships *Hiei* and *Kirishima* were sunk, Admiral Yamamoto lost his will to continue the struggle for Guadalcanal and withdrew the Combined Fleet far back in preparation for a long war that he already knew was impossible to win. The November Naval Battles around Guadalcanal decisively changed the course of the Pacific War in favor of the US and thus decided the fate of Japan.

[113] The Naval Battles of Guadalcanal took place from 11 November through to 15 November 1942. USS *Enterprise* (CV-6) played a pivotal role in sinking *Kirishima*'s sister ship *Hiei,* as well as 7 of the 11 troop transports bringing in Japanese re-enforcements, on the days leading up to the final night battle carried out by USS *Washington* and USS *South Dakota*. When the Naval Battle of Guadalcanal began, both *Enterprise* and *South Dakota* still carried battle damage suffered on 26 October 1942 during the Naval Battle of Santa Cruz. The tactical situation at Guadalcanal was considered to be so critical that neither ship could be sent out of the war zone for repairs.

Bibliography

PRIMARY SOURCES

Official Documents

Bureau of Ordnance (BuOrd), OP 1667, Japanese Explosive Ordnance

Bureau of Ships (BuShips)

– War Damage Report No. 57, 1 June 1947. U.S.S. SOUTH DAKOTA (BB57), Gunfire Damage, Battle of Guadalcanal, 14-15 November 1942
– Builder plans for USS *South Dakota*

Reports of the U.S. Naval Technical Mission to Japan

– O-17 Japanese Naval Projectile Fuzes
– O-19 Japanese Projectiles General Types
– O-25 Japanese Explosives
– O-47(N1) Japanese Naval Guns and Mounts, Article 1 - Mounts under 18”
– O-54(N) Japanese Naval Guns

Japanese Action Reports

– *Atago* Direct Action Report No. 8, 12 to 14 November 1942 (submitted 18 November 1942)
– *Ikazuchi* Direct Action Report, 14 to 15 November 1942 (submitted 15 November 1942)
– *Kirishima* Brief Action Report JT 1, National Archives
– *Sendai* Brief Action Report JT1, National Archives
– *Takao* Brief Action Report JT 1, National Archives

United States Action Reports and Deck Logs

– Admiral W.A. Lee. Report of Night Action Task Force 64 – Night of November 14-15, 1942
– USS *South Dakota*. Action Report, night engagement 14-15 November, 1942, with Japanese naval units, off Savo Island.
– USS *Washington*. Action Report, Night of November 14-15, 1942.
– USS *Washington*. Deck Logs – Night Action – 14-15 November 1942

United States Strategic Bombing Survey, Interrogations of Japanese Officials, Interrogation Nav No. 33, USSBS No. 138, Interrogation of LCDR Tokuno Horishi

SECONDARY SOURCES

Books (English)

Campbell, John. *Naval Weapons of World War Two*. Conway Maritime Press, 1985.

Dull, Paul S. *A Battle History of the Imperial Japanese Navy 1941-1945*. Naval Institute Press, 1978.

Evans, David C. and Mark R. Peattie. *Kaigun*. Naval Institute Press, 1997.

Frank, Richard B. *Guadalcanal*. Penguin Books, 1990.

Garzke, William H. and Robert O. Dulin, Jr. *Battleships: United States Battleships*. Naval Institute Press, 1995.

Grace, James W. *The Naval Battle of Guadalcanal: Night Action, 13 November 1942*. Naval Institute Press, 1999.

Hammel, Eric. *Guadalcanal: Decision at Sea*. Crown Books, 1988.

Lacroix, Eric and Linton Wells II. *Japanese Cruisers of the Pacific War*. Naval Institute Press, 1997.

Skulski, Janusz. *The Heavy Cruiser* Takao. Naval Institute Press, 1994.

Books (Japanese)

Handō, Kazutoshi (ed.). *Nippon Gunkan Senki* [Battle Records of Japanese Warships]. Bunshun Bijuaru-han, 1996.

Kaigun Hōjutsu-shi [The History of Naval Gunnery]. *Kaigun Hōjutsu-shi Kankōkai*, 1975.

Shikikan-tachi no Taiheiyō Sensō [Pacific War as Described by the Senior Officers]. Kōjinsha NF Bunko, 2004.

Toyoda, Jō. *Kūbo Shinano no Shōgai Yonhon no Hibashira: Kōsoku Senkan Yūsenki* [Four Pillars of Fire: The Battle Records of Fast Battleships]. Shūeisha Bunko, 1979.

Yoshimura, Akira. *Senshi no Shōgensha-tachi* [Witnesses of the Pacific War]. Bunshun Bunko, 1999.

Gakken Pacific War Series:
– Vol. 5. *Soromon Kaisen* (The Solomons Campaign), 2000.
– Vol 6 *Shitō Gadarukanaru* (Deadly Battle for Guadalcanal), 2000.
– Vol. 21 *Kongō-gata Senkan* (*Kongō* Class Battleships), 1999.

Articles (English)

Lengerer, Hans. "The *Kongō* Class" *Contributions to the History of Imperial Japanese Warships*, No. 2, March 2007, pp 18-30; No. 3, Sep. 2007, pp 25-44.

Lundgren, Robert. *The Battleship Action 14-15 November 1942*

Okun, Nathan.
– TABLE OF METALLURGICAL PROPERTIES OF NAVAL ARMOR & CONSTRUCTION MATERIALS
– MISCELLANEOUS NAVAL-ARMOR-RELATED FORMULAE
– *Kirishima*'s Hit on South Dakota
– Underwater Projectile Hits

Articles (Japanese)

Kobayashi, Michio. "*Senkan 'Kirishima' no Saigo* [The Last of Battleship *Kirishima*]." *Saiaku no Senjō Gadarukanaru Senki*, 1987, pp 350-361.

Yoshino, Kyûshichi. "*Senkan 'Kirishima' no Saigo* [The Last of Battleship *Kirishima*]." *Maru Extra Vol. 10*, May 1998, pp 54-57.

Naval Memorials

USS *Alabama* Memorial Park, Mobile, Alabama

Special Thanks to Bill Tunnel of USS *Alabama* for all his help

Computer programs

MS QuickBasic 4.5 computer program EXTERIOR BALLISTICS 6G1109

Websites

Japan Center for Asian Historical Records (JACAR). National Archives of Japan: http://www.jacar.go.jp/
Kobe University Library Digital Archive: http://www.lib.kobe-u.ac.jp/
Kure Maritime Museum (Yamato Museum): http://yamato.kure-city.jp/
National Institute for Defense Studies (NIDS, Bōei Kenkyūjo): http://www.nids.go.jp/
NavSource Naval History: http://www.navsource.org/
NavWeaps: http://www.NavWeaps.com/

Translations

Special thanks to Sander Kingsepp for his help and expertise in translating Japanese documents.