

A Summary of Findings Which Caused the Deep Dive of the USS CHOPPER (SS 342) 7 October, 1969

The USS CHOPPER is a Guppy 1A diesel powered submarine. On 11 February, 1969, USS CHOPPER (SS 342) was operating off the coast of Cuba in waters with an average depth of 1800 fathoms (10,800 feet). USS CHOPPER was operating with the USS HAWKINS (DD 873).

At 1340 hours the status of the USS CHOPPER (SS 342) control mechanisms were as follows:

1. Submerged at 150 feet.
2. Trim angle about 1 degree down.
3. Rudder angle unknown.
4. Speed full ahead rung up (230 RPM) and answered on both shafts.
5. Speed between 7 and 9 knots.
6. Bow planes in emergency power for training purposes.
7. Stern planes in normal power.
8. Bow and stern planes indicating between 5 up and 5 down as required to maintain ordered depth and ordered 1 down angle.
9. Normal plane angle indicators and emergency planes angle indicators functioning properly.
10. Submarine in trim and trim pump and trim manifold secured.
11. Main ballast tanks and Safety Tank vents open and bow buoyancy vent shut.
12. Submarine was conducting unlimited (except restricted to 150 foot depth on orders of Commanding Officer) evasive maneuvers as directed by the exercise message.
13. Two of the four ICMG (interior communications alternating current motor generators) #3 and #5 were providing AC power to lighting systems, normal indicator systems, MC speaker systems, sonar systems, radio and other equipments requiring AC power throughout the submarine.
14. The state of the submarine's batteries was at one half capacity. The batteries specific gravity was estimated to have been between 1.135 and 1.140 at the time of AC failure. There was no unusual activity or events taking place aboard.

Loss of Alternating Current

At about 1342 on 11 February, 1969 (approximately two minutes later) with all ahead full being answered, without knowledge of any personnel on board as to probable cause, the two on line AC ICMG motor generators suddenly tripped off without warning, causing immediate loss of functions of the following equipments on board USS CHOPPER (SS 342) which were dependent on AC power:

1. All alarms (except diving alarm)
2. 1 and 7 MC speaker systems.
3. Hydraulic accumulator indicator.
4. Motor order telegraphs.
5. TP-TR (hull and ballast tank opening indicator panel) board.
6. 27 MC speaker system.
7. Shaft revolutions indicator.
8. Normal bow and stern plane indicators.
9. Normal rudder angle indicator.
10. Bow planes rigging indicator.
11. Rectified 6 volt DC power for:
 - a) Auxiliary angle indicator.
 - b) auxiliary bow and stern plane angle indicators.
 - c) TP-TR (hull and ballast tank opening indicator panel).
 - d) AC lighting.
 - e) All sonar equipment.
 - f) All radio equipment.
 - g) Auxiliary gyro synchro amplifier.
 - h) All other electronic equipment.
12. The stern planes were considered to be at full dive at the instant of AC power loss.

Sequence of Events - 0 to 5 Seconds After Loss of AC Power

1. The Officer of the Deck ordered all ahead one-third and commenced moving from a position by number 2 periscope to a position next to lower conning tower hatch.
2. The officer conning the submarine under instruction, observing "J" scope (Sonar) simultaneously ordered all ahead one-third.
3. The diving officer looked at and observed that normal indication for bow and stern planes was not functioning; and the emergency bow and stern plane angle indicator lights were not functioning and that he had no indication whatsoever of the actual position of either bow or stern planes.
4. The hydraulic manifold operator, noticed that he had no light indication on the TP-TR (hull and ballast tank opening indicator panel) board.
5. The I.C. Electrician of the watch moved to the gyro compass control panel in order to shift gyro filaments power supply as is required upon the loss of AC power.
6. The auxiliaryman moved to a position adjacent to and facing the air manifold.
7. The attitude of the submarine increased from a "slight down angle" of 2 or 3 degrees to between 12 and 15 degrees down. The Officer of the Deck ordered all ahead one third.
8. The officer conning the submarine simultaneously ordered all ahead one third.
9. The Diving Officer noticed there was no normal or emergency indication of the position of the bow or stern planes.
10. The hydraulic manifold operator noticed he had no indication on the TP-TR (hull and ballast tank opening indicator panel) board.
11. The I.C. Electrician of the watch moved to the gyro compass control panel in order to shift gyro power supply to filaments only as is required upon the loss of AC power.
12. The auxiliaryman moved to a position adjacent to and facing the air manifold.

Sequence of Events - 5 to 15 Seconds After Loss of AC Power

1. The attitude of the submarine increased from a slight down angle of 2 to 3 degrees to between 12 and 15 degrees down.
2. The helmsman picked up the sound powered hand phone in the conning tower (XJA circuit inter compartmental sound powered phone system) and rang maneuvering room twice and ordered all ahead one third as instructed by the conning officer. The order was not heard or acknowledged in maneuvering. (It was not substantiated by later evidence that the maneuvering room was actually called up or that the sound powered phones were not functioning.)
3. The instructor planesman took charge of the planes.
4. The commanding officer left the wardroom and proceeded towards the control room.

Sequence of Events - 15 to 30 Seconds After Loss of AC Power

1. The rate of change of increasing down angle accelerated rapidly from about 15 degrees down to approximately 40 to 45 degrees down; with full speed ahead still being answered.
2. The starboard controllerman on watch in the maneuvering room picked up the XJA circuit (inter compartmental sound powered phone system) but heard no conversations.
3. The Officer of the deck took the hand telephone from the helmsman and ordered "All stop" and immediately "All back full". There was no response to this order, nor was it heard in the maneuvering room.
4. The after torpedo room watch picked up the hand phone (XJA circuit) and heard no conversation on the phone.
5. The diving officer ordered "Blow bow buoyancy" and the auxiliaryman responded to the order. In addition the diving officer ordered the stern planesman to shift to emergency and the stern planesman responded to the order.
6. The commanding officer entered the control room and was able to pull himself to a position between the ladder from control to conning tower and the control room table.
7. One of the chiefs fell to the forward end of the forward battery as he attempted to climb into the control room.
8. The hydraulic manifold operator shut the forward group and safety vents. Bow buoyancy vent was shut and safety vent was open.
9. The stern planesman shifted plane control to emergency.
10. The diving officer or commanding officer ordered "blow the forward group, blow safety."
11. The engineering officer arrived at the crew's berthing compartment in the after battery and was unable to proceed further.
12. The auxiliaryman blew the forward group and safety as ordered.
13. The diving officer ordered both planesman to shift to hand power.
14. Water started flowing out of the auxiliary vent manifold and into the I.C. board.
15. In the maneuvering room, the senior controllerman on the starboard side of the cubicle after attempting to communicate repeatedly with control room on hand phone, looked at the pressure gauge mounted on the bulkhead by his right shoulder and noted that the gauge indicating 150 psi (330 + feet) and estimated that the down angle was about 40 to 45 degrees at which time he ordered the port controllerman to come to "All back full", both men took this action immediately.
16. At the diving stand in the control room, the angle indicator was pegged in the down angle position, over 45 degrees, and the depth gauge was passing 400 feet.
17. The air manifold operator cut-in air banks 1 and 5 in response to the commanding officer's orders.
18. At this stage, with a down angle of about 45 degrees, further controlled movement of personnel throughout the submarine was next to impossible and a tremendous amount of loose material of every nature was moving forward violently.

Sequence of Events - 30 to 60 Seconds After Loss of AC Power

1. The submarine's down angle continued to increase and the forward and downward travel of the submarine was decelerating due the applied all back full propulsion and the affect of blowing bow buoyancy, forward group and safety tanks.
2. The planesmen continued to struggle with the planes, in hand power, attempting to place them in a rise position.
3. The commanding officer was attempting to calm the men and in control and restore order.
4. The submarine reached a maximum depth of approximately 1011 feet in the bow section, approximately 720 feet in the after section with an angle greater than 75 degrees down.

Sequence of Events - 60 to 70 Seconds After Loss of AC Power

The submarine's downward motion was reduced to zero. The submarine gained sternway (movement in reverse) in a near vertical position, bow down followed immediately by a change in attitude as the submarine started toward and through zero angle into an up angle and change of momentum toward the surface. In addition, the following sequence of events occurred:

1. The bow plane mechanical indicator was observed passing from a dive to a rise position at about the moment the submarine went through a neutral angle.
2. The commanding officer ordered "Forward group vents opened", however the hydraulic manifold operator could not or did not immediately respond to orders.
3. The commanding officer ordered "All stop" which was answered by maneuvering.
4. The diving officer ordered both planesman to "Get the rise off" (Still no indication or reports on mechanical indicators as to planes position)
5. The diving officer ordered, "Secure the blow to bow buoyancy and forward group, which was acknowledged and accomplished by the air manifold operator.
6. The commanding officer ordered, "All ahead full", which was acknowledged and done by maneuvering.
7. The after torpedo room requested permission to load one red combination flare (never acknowledged or accomplished).
8. Note: With the exception of a small leak in air conditioning overboard discharge line, no major salt water system internal to the submarine had failed, though the submarine was not rigged for deep submergence and was in a neutral angle at about 740 feet at this moment.

Sequence of Events - 70 to 120 Seconds After Loss of AC Power

The submarine up angle rapidly increased to at least 83 degrees and the submarine quickly accelerated in a forward and upward motion, during which time the diving officer reiterated the commanding officer's order to , "Open the forward group vents", to which the hydraulic manifold operator responded. The air manifold operator received an order from an unknown source to, "Blow the after group", and complied. The diving officer repeated his order to, "Get the rise off the planes".

Note: All the loose material which had accumulated on the forward bulkheads of all compartments, except maneuvering room, now literally "fell" aft through the air and crashed in mass on after bulkheads. One deck plate in the forward torpedo room sailed through the air, from between the torpedo tubes, passed through the forward battery. In the sonar room there was a stop watch hanging by a three inch long loop from a knurled knob which secures a vertical panel on sonar stack. This stop watch fell from the knob on which it was hanging during the up angle. In order to cause the loop holding the watch to slip off the knurled knob it is necessary to tilt the panel outward from a vertical position to a near horizontal angle of at least 82 degrees. At this stage of the incident many personnel could no longer recall what occurred, as evidenced by written statements and tape recordings.

Sequence of Events - 120 to 150 Seconds After Loss of AC Power

The submarine broke the ocean's surface in a near vertical attitude and rose to a position which almost cleared the after sail area, before settling stern first to a completely submerged condition stern down. The conning tower depth gauge was observed to read 205 feet at the deepest point of reentry, at which time the forward group, bow buoyancy and safety vents were shut. The submarine resurfaced at an angle of about 40 degrees and remained on the surface, dead in the water. The high pressure air manifold was secured. The submarine returned to the surface for the second time at about 1345.

The BT trace card in use during this incident does not disclose any indication of extreme thermal gradient. All variable ballast tank readings were the same both prior to and subsequent to the incident.

Findings

1. The CHOPPER (SS 342) was able to restore sufficient propulsion machinery so as to return to port under her own power.
2. The I.C. Electrician on watch was not "aware" that the transfer switch which provides AC/DC power to emergency indicators was not of the automatic relay type which provides 6 volts DC emergency power to angle indicators upon loss of AC power.
3. The diving officer was aware that the transfer switch which provides AC/DC power was not of the automatic type, however he did not at anytime during the incident order the I.C. Electrician of the watch or any other person to shift the switch to the DC power supply position.
4. The diving officer upon noticing that there was no lighting on the TP-TR panel indication board assumed that all DC power forewarn had been lost causing loss of pressure in the hydraulic system. He therefore ordered planesman to "shift the planes to hand power" and attempted to pass the word over the XJA handset to "Shut all vents by hand". The order to shut vents by hand was not acknowledged by any person.
5. The hydraulic manifold operator on two occasions shortly after loss of AC power requested emergency indication for the TP-TR board. His request was not acknowledged.
6. The "WARNING" plate specified in Blueprint No SS-6505-H-806820 to be found mounted in the vicinity of the control room I.C. switchboard could not be found. (NOTE: "WARNING! LIGHT OUT INDICATES THAT 6-8 VOLT BUS ON I.C. SWITCHBOARD IS BEING SUPPLIED FROM THE EMERGENCY 6 VOLT BATTERY.")
7. The conning officer under instruction used the conning tower handset phone (XJA circuit) approximately 15 minutes prior to the loss of AC power and engaged in a conversation with the after torpedo room watch and experienced no difficulty whatsoever.
8. Damaged or Out of Commission Equipment
 - a. No. 3 and No. 4 ICMG sets- flooded with salt water and fuel oil.
 - b. FTR GSIR- hit with a deck plate
 - c. No. 3 torpedo tube outer door in hand- inoperative.
 - d. OMA (Cavitation indicator hydrophone)-flooded
 - e. BQR2-B2 (passive sonar) 2 hydrophones-flooded
 - f. 1/64" leak in expansion joint forward of "B" valve- hole was there previously, but chipped paint expose the hole.
 - g. Starboard main motor circulating water pump motor-flooded with salt water.
 - h. Shallow water depth gauge in control room- depth.
 - i. Master gyro-mercury spilled out.
 - j. Low ground reading in battery wells- spilled electrolyte.
 - k. Lighting voltage regulator (No. 1) - salt water.
 - l. Stern light - flooded.
 - m. No. 2 air condition circulating water pump motor-salt water
 - n. Forward torpedo room lower hatch does not seat-depth.
 - o. No. 2 auxiliary tank does not hold air pressure-depth
 - p. Manometers No. 3 and No. 4 main engine- broken by falling gear.

Convening Authority Comment

The first attempt by conning tower to call the maneuvering room is considered to have failed as a result of the selector switch on the E-call being in some position other than the maneuvering room, or due to a low intensity ring not heard in the maneuvering room because of the high background noise which normally accompanies a full bell in the after portion of the ship. The conning tower phone had been used just prior to the loss of AC power to the after torpedo room. The selector switch may not have been placed in the maneuvering room position. After this first attempt to call the maneuvering room, the E-call was neglected. For a few following seconds orders were issued by the OOD in the blind. It is considered that phones were not yet manned in the maneuvering room when the OOD issued his orders in the blind.

The loss of AC power was related to the battery gravity (charge condition), the propulsion orders immediately before the loss of AC power and the resulting auxiliary voltage fluctuations from the propulsion orders of full ahead.

Lessons Learned And Action Taken As a Result of The USS CHOPPER (SS342) Casualty

Following the loss of AC power the CHOPPER experienced a depth excursion to approximately 1000 feet. Large angles up to about 84 degrees were taken. The following lessons to be learned are derived from this incident.

1. Shipboard personnel should be knowledgeable regarding the rated load capabilities of installed ship's service ACMG sets. While underway the number of ACMG sets in operation should be sufficient so that the loss of one ACMG will not override the remaining sets. The loss of one or more ACMG sets and possibly the loss of all AC power may be caused by transient CC voltages. These transient voltages are superimposed on DC circuits when the circuits are subjected to current surges and current interruptions. In answering bells, controllerman in the maneuvering room should observe current surges and allow the surges to decay before proceeding with the steps that normally follow. This area of transient voltages/current surges is being pursued with NAVSHIPS and more information will follow.
2. Deck plates in the forward Torpedo Room were not bolted down. They literally fell from one end of the department to the other when the ship took large angles. Only through chance were there no serious injuries as a result of these flying objects.
3. Auxiliary plane angle indicators are operated by a sliding type contactor. By design these contactors are capable of adjustment so that a light is always on and therefore the position of the planes (or rudder) is always known. All auxiliary indicators should so adjusted or a report made that they don't meet design specifications.
4. Loss of AC power on a diesel submarine causes a rapid communications with maneuvering, namely MB circuits and 1 & 7 MC if this failure occurs at high speed, the ship is left with reduced ability to recover from a depth excursion. COMSUBLANT is

working toward and emergency communication system to improve this situation. However, until a modification is approved and installed, the consequences of an AC power casualty should be thought out ahead of time by all watch standers, particularly when ship speeds are over about 5 knots. The practice of enduring the E call selectors on the conning tower and control room phones are returned to "Maneuvering" after each use should be instituted.

5. It was apparent in this casualty that all watch standers were not thoroughly checked out on indications, corrective actions, and differences between loss of AC power, loss of DC power, loss of main hydraulic power, and loss of normal hydraulic power to the planes. Drills on these causalities should be conducted until COW, (chief of the watch) planesman, Diving Officer, and I.C. Electrician recognize quickly and accurately which causality has occurred and know by rote how to correct it.

6. DC indicators for bow and stern planes and rudder are sometimes called emergency indicators. This terminology could be confused with emergency power to the planes or rudder. DC indicators should be called "Auxiliary Angle indicators" and not "Emergency Angle indicators".