

<p>SHOW: "NUCLEAR SUBMARINES" MODERN MARVELS – THE HISTORY CHANNEL JANUARY 3, 2001 WRITER/PRODUCER/DIRECTOR: ADRIAN MAHER</p>	
	<p>TEASE: THEY ARE INVISIBLE, ALL-POWERFUL - THE MOST LETHAL FORCES ON EARTH. THEY SECRETLY ROAM THE OCEANS, ABLE TO RAIN UNSPEAKABLE DESTRUCTION ANYWHERE ON THE PLANET....NOW, NUCLEAR SUBMARINES ON MODERN MARVELS.</p>
	<p>THESE STEEL SHARKS OPERATE IN A HARSH, UNSEEN, TWILIGHT WORLD. THEY MANEUVER THROUGHOUT 70% OF THE EARTH'S SURFACE IN A DEADLY GAME OF STEALTH, INTRIGUE AND MENACE. SOME CARRY MORE FIREPOWER THAN ALL THE BOMBS DROPPED IN WORLD WAR II - MARINE MONSTERS THAT CAN BE AS QUIET AND UNTHREATENING AS A BLOWFISH, BUT AROUSED, CAN FIRE THE WORLD'S MOST DEADLY CARGO FROM MORE THAN 100 FEET UNDERWATER.</p>
	<p>Tom Clancy, Author: Hunt for Red October, (53476) 03:22:43 A submarine is a, is a platform whose mission is to arrive by stealth, to kill without warning, and to escape without damage to herself. // (53475) 02:20:24 They contain a whole lot of capability into a very small space. They allow a hundred or more people to live in that small....space comfortably and productively for relatively long periods of time. They're invisible. They have immense uh military capabilities...they're just amazingly efficient machines.</p>

	<p>NUCLEAR SUBMARINES ARE PRICELESS MILITARY JEWELS - OWNED AND OPERATED BY ONLY A HANDFUL OF COUNTRIES. THEY ARE DRIVEN BY THE NEAR LIMITLESS ENERGY OF ATOMIC POWER AND WITH OTHER ADVANCED NAVAL TECHNOLOGIES, ARE THE MOST COMPLICATED MECHANISMS EVER BUILT. THEY OPERATE IN A MORE TREACHEROUS ENVIRONMENT THAN SPACE.</p>
	<p>Commander Jerry Burroughs, Commanding Officer, USS Albuquerque (53799) 09:15:55 There's 4400 pounds per hundred foot of depth pressure on the ship . It's cold. It's dark. There's currents. There's storms that can come up. // 09:13:42 We're submerged. We have to make our own air. We have to filter our air, remove carbon dioxide. We make our own power, our own water. // 09:15:55 There's any number of things that can go wrong, it's truly an unforgiving place.</p>
	<p>TWO TYPES OF NUCLEAR SUBMARINES PROWL THE OCEANS. "ATTACK" SUBS QUIETLY HUNT OTHER SUBS, MONITOR SURFACE SHIPS AND PROVIDE INTELLIGENCE. BALLISTIC MISSILE SUBMARINES OR "BOOMERS" CARRY MISSILES TOPPED WITH NUCLEAR WARHEADS THAT CAN WIPE OUT COUNTRIES. THEIR MISSION IS TO "HIDE WITH PRIDE," AND TO DETER ADVERSARIES FROM MILITARY ACTION.</p>
	<p>Sot: "Fire"</p>
	<p>THESE BOOMER AND ATTACK SUBS ARE MADE WITH MORE THAN 80 MILLION SEPARATE PARTS, CAN COST MORE THAN TWO BILLION DOLLARS AND WITH 3,000</p>

	<p>WORKERS, CAN TAKE A DECADE TO BUILD. ONCE AT SEA, THEY STAY SUBMERGED FOR MONTHS, SILENTLY FERRYING A CREW OF SECRET WARRIORS TO POINTS ALL OVER THE GLOBE.</p>
	<p>Dr. Norman Friedman, Naval Historian, (53630) 09:01:18 You have no contact with the outside world. Everything you're going to live with goes with you. You stay there for 90 days. You don't die. In fact, you live fairly well....the only other place you can imagine doing that would be a space capsule.</p>
	<p>THIS IS THE USS ALBUQUERQUE - AN ATTACK SUBMARINE OPERATING IN THE U.S. ATLANTIC FLEET. IT'S MISSION IS MANIFOLD: TRACKING ENEMY SUBMARINES, SEARCH AND RESCUE, INSERTING NAVY SEALS INTO LAND OPERATIONS, AND ANTI-SHIP WARFARE. THE BOAT'S TEETH ARE IT'S NON-NUCLEAR, YET LETHAL TOMAHAWK CRUISE MISSILES, MK48 TORPEDOS AND A CLUSTER OF OCEAN MINES. A PELLET-SIZED CHUNK OF URANIUM PROVIDES THE SUB MORE ENERGY THAN 30,000 GALLONS OF GASOLINE. ITS 35,000 HORSEPOWER NUCLEAR REACTOR, PUTS OUT LESS NOISE THAN A SCHOOL OF SHRIMP FEEDING. THE BRAIN OF THIS WILY SEA CREATURE IS THE CONTROL ROOM OR ATTACK CENTER, BATHED IN RED LIGHT DURING NIGHTTIME TO PROVIDE A SENSE OF TIME TO THE CREW.</p>
	<p>Admiral Kinnaird McKee, Retired 4-Star Admiral, (53637) 02:16:47 The control room is the place where you navigate, you control the depth, angle and course of the</p>

	<p>submarine. It's where you receive information from the various sensors..... and consolidate it into the fire control system. It's where you plot the course and speed of the target. It's where you launch the weapon. It is the nerve center of the whole ship.</p>
	<p>AS THE BOAT SUBMERGES INTO A TIMELESS TWILIGHT OF DEEP-OCEAN DARK, ITS ONLY EYES ARE THE SONAR ROOM.</p>
	<p>Tom Clancy (53475) 02:03:50 Underwater you can't see anything because water absorbs light energy very, very rapidly. But it allows the transmission of acoustical energy to great distances. And so the one sense, the one input you have underwater is sound. 02:27:06 Sonar is your one eye onto the world. So all your information, essentially, on what's happening around you comes from, from the four or five guys who are sitting in the sonar room....they are therefore the most important enlisted men aboard the submarine.</p>
	<p>ACTIVE SONAR, WHICH SENDS OUT SOUNDS OR PINGS, IS EMPLOYED SPARINGLY BECAUSE IT CAN GIVE AWAY A SUB'S POSITION. INSTEAD, THE BOAT OFTEN EMPLOYS PASSIVE SONAR THAT SIMPLY LISTENS FOR SOUNDS IN THE OCEAN.</p>
	<p>Byron Roberts - Chief Sonar Technician (53799) 09:06:26 We can hear the merchants. We can actually hear their screws going through the water. We can tell how fast they're going. We can hear dolphins, whales. // 09:07:24 The most unique sound is when we're up around the ice and you're hearing the creaking and the breaking up of the ice, the ice flows</p>

	<p>coming out. That is the weirdest sound. It sounds like ghosts.</p>
	<p>THE LONG STEEL TUBE IS DENSELY PACKED WITH HARDWARE. A NUCLEAR REACTOR TAKES UP THE BACK THIRD OF THE BOAT. WEAPONS AND TONS OF ELECTRONIC GEAR LEAVE LITTLE ROOM FOR THE CREW. PRIVACY IS LIMITED - THERE ARE NO SECRETS ON A NUCLEAR SUB. EACH ENLISTED MAN GETS ABOUT 15 SQUARE FEET OF SLEEPING AND STORAGE SPACE.</p>
	<p>Mark Pinoski - Petty Officer (53807) 07:01:30 When I try to sit up, I can't because the overhead is very, very small, impossible to sit up at all. To try to turn sideways is almost impossible. This is my storage space right here.</p>
	<p>TO COUNTER THE ISOLATED, REMOTE EXISTENCE OF SUBMARINERS, TECHNOLOGY ENSURES ALL THE MODERN AMENITIES. ELECTRICITY PROVIDED BY THE NUCLEAR REACTOR FILTERS THE AIR TO REMOVE DUST AND CARBON DIOXIDE GAS. BETWEEN 10,000 AND 40,000 GALLONS OF FRESH WATER IS PRODUCED EVERY DAY BY BOILING SEAWATER AND COLLECTING AND CONDENSING ITS STEAM. FRESH OXYGEN IS CREATED BY PUMPING WATER THROUGH A SIX BY SIX FOOT STEEL BOX OF ELECTROLYTIC CELLS. THE ELECTRICITY SEPARATES THE WATER'S HYDROGEN AND OXYGEN ELEMENTS AND THEN PUSHES THE NEW OXYGEN THROUGHOUT THE BOAT. THE HYDROGEN IS MIXED WITH EXCESS WATER AND DUMPED</p>

	BACK INTO THE OCEAN.
	THOUGH EACH BOAT IS BLESSED WITH NEAR ENDLESS NUCLEAR POWER, FOOD IS THE ONE ENERGY SOURCE THAT LIMITS TIME AT SEA. AS A SHIP HEADS OUT ON PATROL, EVERY NOOK AND CRANNY IS JAMMED WITH PROVISIONS. THE QUIET GLADIATORS THAT MAN THESE VESSELS KEEP TO A TIGHT 18-HOUR CYCLE. SIX HOURS ON WATCH, TWELVE HOURS FOR STUDY, MAINTENANCE, EATING AND SLEEPING, THEN BACK ON WATCH AGAIN.
	Jerry Burroughs (53799) 09:28:27 We don't, we can't turn the lights out at night and say okay, we'll see you guys in the morning. We're 24/seven going around the clock.
	A RATION OF EMAILS FROM FRIENDS AND RELATIVES, ALLOTTED BY THE CAPTAIN, KEEPS UP MORALE ON THE VESSEL.
	Bruce Lee - Chief Officer (53810) 00:09:23 Got an email from my 15 year-old daughter Annabelle. Says Dad, good news from home. I got all A's and one B on final report card....four weeks away from home and that's what it's all about. Makes my day - makes me happy.
	BUT SUCH RESPITES ARE RARE. DRILLING SEEMS CONSTANT. IN THE TORPEDO BAY, THE WEAPONS ARE ROUTINELY RACKED AND SLOTTED FOR SIMULATED ATTACKS.
	Jerry Burroughs (53799) 09:26:46 The job we're doing is very complex, and it's very involved. And to get 100 people or 135 people doing the right thing at the right time, which is what it takes to successfully

	employ the ship, takes a lot of practice.
	ONLY AFTER 20 YEARS OF TRAINING, DOES COMMANDER BURROUGHS GET TO PRESIDE OVER THIS SECRET FRATERNITY WHERE HE ASSUMES GODLY POWERS.
	Jerry Burroughs (53799) 09:20:46 The Captain...has to know engineering. If it's a nuclear powered ship you have to know the physics to go with it, you have to know tactics, you have to know sonar, you have to know navigation, you have to know ship handling.
	A BOAT CAPTAIN MUST ALSO HAVE A COLLECTION OF UNASSAILABLE PERSONAL QUALITIES.
	Tom Clancy (53476) 03:05:21 Instinct, an artist's touch. Monomaniacal confidence of a professional boxer. People who feel very secure and very confident...good at at handling other people. They have to be good at leadership....They're warriors.
	SOME OF THE WORLD'S BEST SCIENTIFIC MINDS WERE RECRUITED TO BUILD THESE SILENT BEASTS. NEXT, THE CREATION OF THE MODERN NUCLEAR SUBMARINE WAS FUELED BY AMBITION, ACCIDENTS AND AT TIMES, TRAGEDY.
	FACTOID: FOR A 90-DAY DEPLOYMENT, A TYPICAL U.S. NUCLEAR SUB IS PACKED WITH 1300 POUNDS OF BEEF, 500 POUNDS OF FISH, AND 1300 EGGS AMONG OTHER FOODSTUFFS.
	NUCLEAR SUBMARINES WILL RETURN ON MODERN MARVELS.
ACT TWO	
	WE NOW RETURN TO NUCLEAR

	SUBMARINES ON MODERN MARVELS.
Graphic?	TODAY, ABOUT 160 NUCLEAR SUBMARINES SILENTLY TRAVERSE THE EARTH'S OCEANS. BUT MORE THAN TWO CENTURIES AGO, THE WORLD'S FIRST SUBMARINE HAD A MORE LIMITED ROLE. IT WAS CALLED THE "TURTLE" AND WAS BUILT BY DAVID BUSHNELL FOR GEORGE WASHINGTON FOR USE AGAINST THE BRITISH IN 1775. THE BOAT WAS SEVEN FEET LONG, HAD A HAND-CRANKED PROPELLER AND COULD STAY SUBMERGED FOR 30 MINUTES. IT'S ONE MISSION FAILED WHEN THE SUB WAS UNABLE TO ATTACH AN UNDERWATER EXPLOSIVE ON TO A BRITISH WARSHIP. BUT THE NECESSITIES OF SEA WARFARE SOON CREATED MORE SOPHISTICATED DESIGNS.
	IN THE AMERICAN CIVIL WAR, THE 60-FOOT CONFEDERATE SUB CSS H.L. HUNLEY USED A BALLAST SYSTEM THAT ASCENDED AND DESCENDED BY ADDING AND SUBTRACTING WATER, THE FOUNDATION OF THE MODERN SUB. IT RECORDED THE FIRST TORPEDO ATTACK AGAINST AN ENEMY WARSHIP - AN EXPLOSION THAT ALSO KILLED THE EIGHT-MAN SUB CREW.
	BY THE 20 TH CENTURY, NEW POWER SYSTEMS GAVE SUBS WIDER RANGE, SPEED AND FLEXIBILITY. JOHN HOLLAND SOLD THE U.S. NAVY ITS FIRST SUBMARINE IN 1900. IT WAS 54 FEET IN LENGTH AND WAS THE FIRST TO OPERATE WITH DUAL PROPULSION SYSTEMS - A GASOLINE ENGINE POWERED THE BOAT ON THE SURFACE AND AN ELECTRIC MOTOR PROPELLED THE VESSEL WHEN SUBMERGED. BY

	<p>WORLD WAR I, THE GERMANS IMPLEMENTED MANY OF HOLLAND'S INVENTIONS AND REVOLUTIONIZED NAVAL WARFARE WITH LARGE NUMBERS OF SUBMARINE SNEAK ATTACKS.</p>
	<p>Kinnaird McKee (53635) 00:02:41 The Royal Navy had a real problem with em, because they, you know, gentlemen don't do that sort of thing...the Germans, of course showed what submarines could do in the First World War, sinking three British cruisers in an afternoon with one ship.</p>
	<p>BETWEEN THE WARS, THE WORLD'S INDUSTRIALIZED COUNTRIES RACED TO BUILD LARGE NUMBERS OF SUBS, BUT DID NOT NECESSARILY IMPROVE THEIR QUALITY. AS LATE AS WORLD WAR II, MOST SUBS WERE STILL SURFACE SHIPS THAT OCCASIONALLY WENT UNDERWATER. THE BOATS CONTINUALLY HAD TO SURFACE TO RUN THEIR DIESEL ENGINES TO RECHARGE THE BATTERIES OF THEIR ELECTRIC MOTORS WHICH POWERED THE BOATS UNDERWATER FOR A MAXIMUM OF 12 HOURS AT A SPEED OF ABOUT NINE KNOTS. THEY WERE UNWIELDY, CRAMPED AND NOISY.</p>
	<p>SOON AFTER WWII, U.S. CAPTAIN HYMAN RICKOVER TOOK OVER THE NAVY'S NUCLEAR PROPULSION PROGRAM AND RELENTLESSLY PUSHED THE DEVELOPMENT OF NUCLEAR SUBMARINES.</p>
	<p>Sot: Admiral Rickover - "There's uranium in here."</p>
	<p>AT THE TIME, ATOMIC ENERGY WAS EVOLVING FROM WEAPONRY TO A POWER SOURCE. BUT IT WAS STILL VIEWED AS DANGEROUS AND</p>

	DESTRUCTIVE. PACKING THE POWER OF NUCLEAR FISSION IN SUCH A LIMITED SPACE SEEMED IMPOSSIBLE.
	Dr. Norman Friedman (53627) 06:04:41 He took a technology that was in it's infancy, 1948 is only a few years after the atomic bomb. And he says, we've made enough studies...we know how to make it work, do it now.
	SUBMARINES AT THIS TIME WERE ABOUT 300 FEET LONG. THE BIGGEST CHALLENGE WAS FITTING A NUCLEAR REACTOR INSIDE THE SMALL SUBMARINE HULL. RICKOVER SET UP AN UNDERWATER TEST FACILITY FOR THE REACTOR IN ARCO, IDAHO. SOON AFTER, HE BEGAN CONSTRUCTION OF THE FIRST NUCLEAR SUBMARINE, NAUTILUS, AT THE ELECTRIC BOAT COMPANY IN GROTON, CONNECTICUT, WHILE SIMULTANEOUSLY TESTING IN IDAHO.
	Dr. Norman Friedman (53627) 06:11:09 He actually built a section of sub, put in the reactor of exactly the type that would go in Nautilus and ran it for 1,000 hours. Ran it for the equivalent of a trip back and forth across the Atlantic. And it worked. And the payoff was that every time they made a change in the test reactor, they could make it back in the Nautilus, because they were identical. And that was a major reason why Nautilus happened as fast as it did.
	PROTECTING THE CREW FROM LETHAL RADIOACTIVITY WAS ANOTHER PROBLEM.
	Sot: Admiral Rickover: "Now a man can walk over this shield and not be irradiated dangerously over a long period of time.

	Admiral Kinnaird McKee (53635) 00:11:35 You had to put enough shielding in the boat to protect the people, and that made the boat heavy. And remember, a submarine's a blimp. The heavier it goes, the bigger it's gotta be so it'll float.
Graphic	THE ENGINEERS CREATED A WORKABLE RATIO BETWEEN THE LEAD SHIELDING AND THE BOAT'S SIZE. ON JANUARY 21, 1954, THE WORLD'S FIRST NUCLEAR SUBMARINE WAS LAUNCHED . IT WAS AN EXTRAORDINARY TECHNOLOGICAL MACHINE . THE NUCLEAR REACTOR POWERED THE BOAT USING HEAT PROVIDED BY NUCLEAR FISSION, THE SPLITTING OF URANIUM ATOMS. THE REACTOR'S HEAT WAS TRANSFERRED TO WATER WHICH CIRCULATED THROUGH A PRIMARY PIPING LOOP THAT ALSO INCLUDED THE REACTOR, PUMPS AND THE STEAM GENERATOR. A SECONDARY LOOP SENT STEAM FROM THE STEAM GENERATOR TO A TURBINE WHICH SUPPLIED THE VESSEL WITH ELECTRICITY, AND TO THE MAIN PROPULSION TURBINE THAT DROVE THE PROPELLER. THE STEAM WAS CONDENSED INTO WATER AND RECIRCULATED BACK INTO THE SYSTEM. NO AIR OR OXYGEN WAS REQUIRED TO RUN THE REACTOR, ALLOWING A SUB TO OPERATE INDEPENDENTLY FROM THE EARTH'S ATMOSPHERE.
	Dr. Gary Weir (53640) 10:15:30 You had a true submarine a la Jules Verne. It could submerge and it did not have to come back up and it could stay submerged indefinitely. The endurance of the crew was the only limitation....the idea that a submarine can now employ stealth to

	<p>maximum effect and is not any longer driven to the surface by the necessity to recharge the batteries. That's completely gone. And for submariners, that was the ultimate rush.</p>
	<p>Dr. Norman Friedman (53627) 06:13:50 You must remember that although there'd been fast subs before there'd never been a sustained high-speed sub. No one had the faintest idea of what say 23 knots was like on an sustained basis. It turned out she could evade any anti-submarine force.</p>
	<p>ON JANUARY 17, 1955, THE BOAT BEGAN ITS FIRST EXTENDED SEA TRIALS WHICH WERE SPECTACULARLY SUCCESSFUL. THE CAPTAIN SENT A RADIO MESSAGE: "UNDERWAY ON NUCLEAR POWER." IT WAS THE BEGINNING OF A NEW AND DANGEROUS ERA. SOON AFTER, THE USS SEAWOLF WAS LAUNCHED AND WITHIN THREE YEARS, THE USS SKATE WAS THE FIRST SUB TO BREAK THROUGH THE ICE AT THE NORTH POLE. THEIR MISSIONS WERE ESPIONAGE, ANTI-SUB AND ANTI-SHIP WARFARE.</p>
	<p>THEN IN 1958, THE SOVIETS, UNDER THE DIRECTION OF ADMIRAL SERGEI GORSHKOV, LAUNCHED THEIR FIRST SERIES OF NUCLEAR SUBMARINES, HOTEL, ECHO AND NOVEMBER, FROM THE SEVMASH BOATYARD NEAR ARCHANGEL IN THE ARCTIC. ALL SOVIET SUB NAMES AND CLASSES WERE DESIGNATED BY NATO FOR REFERENCE BY THE WEST.</p>
	<p>Tom Clancy (53474) 01:22:27 They were very noisy. They were pretty fast. And they were unsafe for the crews. Uh, a lot of sailors on those submarines died, over the</p>

	<p>succeeding years, of radiation poisoning. Because the Russians did not invest the same money or effort in safety for the crews that we did.</p>
	<p>SEVERAL SOVIET SUBS USED A LEAD-BISMUTH (PRONOUNCED BIZ-MUTH) ALLOY - WHICH CIRCULATED AT HIGH TEMPERATURES THROUGH THE NUCLEAR REACTOR. IT ALLOWED FOR A GREATER CONCENTRATION OF ENERGY WHEN HEATING WATER. THE U.S. USED A SIMPLER PRESSURIZED WATER DESIGN AS DID MOST SOVIET SUBS.</p>
	<p>Dr. Norman Friedman (53627) 06:09:55 The great thing about pressurized water was it was inherently very stable. As the water got hotter, the reactor would slow down a little bit, that meant that it wouldn't get out of hand. The water itself wouldn't carry radioactivity...with the liquid metal, you carried a lot more heat out, you could make much hotter steam with it. On the other hand that, that liquid metal does not itself moderate the reactor. So it can run, you can get out of hand....in one case the metal didn't melt properly, they ended up with a solidified radioactive gunk, and they had to cut the sub up.</p>
	<p>Admiral Kinnaird McKee (53636) 01:23:16 The problem with liquid metal is that it gets radioactive and has a very, very long half-life. So, if you have a problem at sea, you can't fix it.</p>
	<p>BACK AT THE TIME NAUTILUS WAS BEING BUILT, THE U.S. CREATED ANOTHER REVOLUTIONARY DESIGN. IN 1953, THE NAVY TESTED A DIESEL SUBMARINE WITH A WHALE-SHAPED OR TEAR-DROP HULL. IT WAS ABLE TO ATTAIN THE</p>

	ASTONISHING SPEED OF MORE THAN 30 KNOTS UNDERWATER.
	Mark Henry (53631) 15:19:54 Prior to the Albacore hull, submarine hull shapes were really optimized for surface operation, to go fast on the surface and then they'd submerge and go slower, while they were doing their operations...the Albacore could go faster underwater than it could on the surface. The Albacore achieved speeds never before seen in submarines.
	DUE TO ITS CYLINDRICAL SHAPE, WATER FLOWED OFF THE ALBACORE BOW MUCH FASTER THAN EARLIER HULL DESIGNS. BY THE MID-1950s, THE U.S. BEGAN BUILDING A SIX-BOAT CLASS OF NUCLEAR SUBMARINE CALLED SKIPJACK. THE CLASS OF VESSELS HAS ALWAYS BEEN NAMED AFTER ITS FIRST BOAT.
	Dr. Norman Friedman (53627) 06:18:18 They redesign the power plant to make it a bit more compact. They combine it with the Albacore hull and zow.
	WHEN THE USS SKIPJACK WAS LAUNCHED IN 1960, THE U.S. NOW HAD A NUCLEAR SUB OF ASTONISHING SPEED, ENDURANCE AND SEEMINGLY ENDLESS POWER.
	Dr. Gary Weir (53640) 10:25:59 When her first skipper brought her back into port after her initial tests he said, "Put a Simonize job on her, I wanna take her home." She was fast. She was maneuverable. She could go deeper than any submarine up to that point in time. And she was the best the Navy had to offer.
	BUT THESE SUBS WERE MINNOWS COMPARED TO THE MONSTERS

	BEING DEVELOPED. NEXT, AS THE COLD WAR HEATED UP, THE U.S. AND THE SOVIETS WOULD CREATE A NEW BREED OF NUCLEAR SUBMARINE WITH SUCH DESTRUCTIVE POWER IT THREATENED THE WORLD.
	FACTOID: THE FIRST THREE SOVIET NUCLEAR SUBMARINES - HOTEL, ECHO AND NOVEMBER, CAME TO BE KNOWN AS THE HEN CLASS - AN ABBREVIATION USING THE FIRST LETTER OF EACH NAME.
	NUCLEAR SUBMARINES WILL RETURN ON MODERN MARVELS.
ACT III	
	WE NOW RETURN TO NUCLEAR SUBMARINES ON MODERN MARVELS.
	BY THE MID-1950s, AMERICA BEGAN WORKING ON A REVOLUTIONARY CONCEPT FOR SUBMARINE WARFARE. A FEISTY, VISIONARY LEADER, ADMIRAL WILLIAM RABORN, WAS PLACED IN CHARGE OF A U.S. PROGRAM TO LAUNCH BALLISTIC MISSILES FROM SUBMERGED SUBMARINES. BUT THE CHALLENGES OF LAUNCHING MISSILES FROM UNDERWATER SUBS SEEMED INSURMOUNTABLE. THE FIRST PROBLEM WAS WATER DISPLACEMENT INSIDE THE SUB ITSELF.
	Dr. Norman Friedman (53628) 07:08:38 You have this large object that the submarine suddenly squirts out, so you have to fill a tank to compensate for the weight, otherwise the submarine will bounce around.
	ENGINEERS DEVELOPED ADVANCED BALLAST SYSTEMS THAT QUICKLY RESTORED

	NEUTRAL BUOYANCY AFTER A LAUNCH, ALLOWING THE SUB TO ABSORB THE SHOCK OF FIRING A MISSILE.
	Tom Clancy (53474) 01:23:30 Technical problem number two is knowing the exact position of the submarine so, so you can deliver the missile to its target safely and accurately.
	NAVIGATION WAS SIGNIFICANTLY IMPROVED WITH ORBITING SATELLITES WHICH RADIOED THE SUB'S EXACT LOCATION TO IT'S COMMANDERS. THEY COULD THEN ACCURATELY CALCULATE THE DISTANCE TO A TARGET. THEN COMPUTERIZED MISSILE GUIDANCE SYSTEMS WERE INSTALLED IN THE WEAPONS TO ENSURE THE CORRECT TARGET WAS HIT. BUT THE MOST DANGEROUS CHALLENGE WAS HOW TO CARRY AND "LIGHT OFF" A LIQUID-FUEL MISSILE INSIDE A SUB.
	Dr. Norman Friedman (53628) 07:11:57 If you kick over a liquid fuel missile, you get a big fire, if you're lucky, and you get a big explosion if you're not.
	LIQUID FUEL WAS THE LEADING PROPELLANT OF THE TIME. BUT IT WAS HARD TO HANDLE, HIGHLY FLAMMABLE AND COULD WREAK HAVOC INSIDE THE CONFINES OF A SUBMARINE.
	Admiral Kinnaird McKee (53635) 00:28:59 The big breakthrough was, that enabled us to do submerged launch, I think was the advent of solid fuel rockets....also the size of the missile itself, the dimensions of the missile got much smaller when we got to solid fuel, which made it easier to

	put it in a submarine hull.
	<p>SOLID FUEL, WAS MADE WITH A COMBINATION OF NITRATE, CARBON AND SULPHUR. IT WAS MUCH SAFER BECAUSE IT WAS BONDED BY PLASTICS, WAS COMPACT AND LESS VOLATILE. INSTEAD OF IGNITING THE MISSILE INSIDE THE SUB, THE WEAPON BELCHED OUT OF THE HATCH WITH COMPRESSED AIR. ROCKET ENGINES THEN IGNITED AND PROPELLED THE MISSILE UP INTO THE ATMOSPHERE. IN DECEMBER, 1959, THE U.S. UNVEILED THE USS GEORGE WASHINGTON, THE FIRST OF A FIVE-BOAT CLASS OF THE WORLD'S FIRST NUCLEAR BALLISTIC MISSILE SUBMARINES..... "BOOMERS." IT WAS A LETHAL SEA-BEAST, A KILLING MACHINE THAT CARRIED 16 POLARIS MISSILES WITH A RANGE OF 1,000 MILES. EACH WAS TOPPED WITH A 50 KILOTON NUCLEAR WARHEAD. THE HIROSHIMA BOMB WAS ABOUT 15 KILOTONS.</p>
	<p>Mark Henry - (53632) 16:06:04 The Polaris submarine provided the United States tremendous advantage in terms of protecting its strategic arsenal. The submarine at sea, submerged, was essentially impossible to find.</p>
	<p>Tom Clancy (53474) 01:25:27 It's kind of hard to develop a countermeasure against something if you don't know where it is. If you don't know where it is, you can't attack and kill it. And so you can't defend yourself against it.</p>
	<p>IN JUST OVER A DECADE, THE U.S. HAD CREATED A NEW BREED OF SUB, ABLE TO STAY HIDDEN AND</p>

	<p>SUBMERGED FOR MONTHS ON END, CARRYING THE LARGEST AMOUNT OF FIREPOWER KNOWN TO MAN. THE MISSION OF THE BOOMERS WAS TO TAKE THEIR LETHAL CARGO AND DISAPPEAR INTO THE SHADOWS OF THE OCEAN'S VASTNESS AND WAIT FOR A COMMAND THAT HOPEFULLY WOULD NEVER COME.</p>
	<p>Admiral Kinnaird McKee (53638) 03:22:16 Submarines give you certainty and uncertainty. It puts in the mind of the opponent a terrible certainty as to what you can do...and a terrible uncertainty as to whether you're gonna do it or when or even if you're there.</p>
<p>GRAPHIC</p>	<p>THROUGHOUT THE 1960s, THE POLARIS MISSILES ON SUBS BECAME EVEN MORE DEADLY BY "STACKING" SEVERAL NUCLEAR WARHEADS ON EACH, GREATLY INCREASING THEIR DESTRUCTIVE POWER. IN 1970, POSEIDON MISSILES INTRODUCED MIRVS OR MULTIPLE INDEPENDENTLY TARGETED RE-ENTRY VEHICLES THAT COULD HIT TARGETS 2,500 MILES AWAY. AFTER A POSEIDON MISSILE COMPLETED ITS THREE - ROCKET BOOST PHASE, ITS NOSE-CONE WOULD REENTER THE ATMOSPHERE AND ITS ATTACHED MULTIPLE WARHEADS OR MIRVS WOULD SPLIT OFF AND DETONATE OVER A WIDE AREA.</p>
	<p>Dr. Gary Weir (53641) 11:19:04 Each one of the warheads can be independently targeted to different cities, locations, industrial sites, military bases. So with one missile you can effectively take out multiple targets. So it multiplies by so many times, the effect of this fleet ballistic missile submarine.</p>

	<p>BUT THE SOVIET UNION REFUSED TO BE LEFT BEHIND. IN 1967, THE SOVIETS LAUNCHED WHAT NATO WOULD CALL THE YANKEE CLASS, A BOOMER SUB WITH 16 BALLISTIC MISSILES WITH A RANGE OF 1300 MILES. IT DISPLACED 9600 TONS AND CARRIED LARGER WARHEADS THAN THE POLARIS MISSILE. THE U.S. COUNTERED IN 1982 WITH THE OHIO CLASS SUB WHICH COULD CARRY 24 TRIDENT MISSILES, EACH WITH UP TO EIGHT WARHEADS OF 100 KILOTONS EACH. JUST ONE OHIO SUBMARINE, LAUNCHING ALL OF ITS 24 TRIDENTS TO A DISTANT CONTINENT WOULD UNLEASH 192 SEPARATE THERMONUCLEAR EXPLOSIONS, RELEASING 19,000 KILOTONS OF ENERGY, ABOUT 1300 HIROSHIMA BOMBS. BESIDES KILLING MILLIONS OF PEOPLE INSTANTLY, THE EXPLOSIONS WOULD DISPERSE AN ESTIMATED TWO MILLION TONS OF RADIOACTIVE DEBRIS INTO THE ATMOSPHERE, ALTERING WEATHER PATTERNS AND THE EARTH'S CLIMATE.</p>
	<p>Dr. Norman Friedman (53629) 08:19:46 One missile can hit an enormous number of targets from a great distance, like 6,000 miles. It's quite a remarkable animal. If you think of it actually being used, it's quite a horrible animal.</p>
	<p>NEXT, AS BOOMER SUBS BEGAN TO PROLIFERATE, THE U.S. AND SOVIETS WERE ALSO POURING BILLIONS OF DOLLARS INTO IMPROVING THEIR ATTACK SUBMARINES, CREATING VESSELS OF UNTOLD STEALTH AND QUIET.</p>
	<p>FACTOID: AS OF 2001, THE U.S.</p>

	EMPLOYED 18 OHIO CLASS NUCLEAR BALLISTIC MISSILE SUBMARINES THAT CAN CARRY A COMBINED FIREPOWER OF MORE THAN 23,000 HIROSHIMA BOMBS.
	NUCLEAR SUBMARINES WILL RETURN ON MODERN MARVELS.
ACT IV	
	WE NOW RETURN TO NUCLEAR SUBMARINES ON MODERN MARVELS.
	AS THE SOVIET UNION BEGAN LAUNCHING MORE NUCLEAR SUBMARINES IN THE EARLY 1960s, THE U.S. BEGAN FOCUSING ON ANTI-SUBMARINE WARFARE TO DEAL WITH THE EMERGING THREAT. U.S. DESIGNERS BECAME OBSESSED WITH QUIETNESS AS A MEANS TO SECRETLY SHADOW, MONITOR AND IF NECESSARY, TAKE OUT THE NEW SOVIET VESSELS.
	Sot: "Con-Sonar - we have a weak noise level bearing 2-9-8."
	Tom Clancy (53475) 02:04:55 If your submarine is so loud it's making fish jump out of the water or holding their ears, and you're not making any noise at all, who's got the advantage?...If you're invisible, the other guy can't hurt you. If you're invisible and he is visible, you win. It's that simple.
	Admiral Kinnaird McKee (53636) 01:06:30 Nautilus was hard-mounted machinery. Very little sound isolation. In that kind of a submarine, the radiated noise follows almost exactly a curve of speed versus power. The faster it goes, the more it radiates. The whole idea with sound quieting is to separate those two. And what you really want it to do is be quiet across the full speed range...Rickover said it, and it's true. Quietening is a lot more difficult problem than just creating the nuclear

	reactor on it.
	SILENCING SOON BECAME A RELIGION FOR U.S. SUB DESIGNERS.
	Dr. Norman Friedman (53628) 07:16:50 The way you make a submarine quiet is you look at that noisy part, that's machinery, mostly geared machinery. You put it on a rigid platform called a raft, you separate the raft from the hull. You put in springs that absorb the sound. That quiets it down enormously.
	THE SPRINGS CAME WITH RUBBER MOUNTS THAT DAMPENED VIBRATIONS. RUBBER TILES COATING THE HULL KEPT ALL SOUNDS INSIDE. EVERY PIECE OF GEAR WAS ANALYZED FOR LUBRICATION AND BETTER-FITTING JOINTS AND VALVES. NOISE MONITORING SYSTEMS WERE PUT IN PLACE TO CATCH ERRANT SOUNDS FROM THE ENGINE'S PUMPS. EVEN KITCHEN UTENSILS USED BY COOKS IN THE SUB'S GALLEY WERE SCRUTINIZED.
	Tom Clancy (53475) 02:03:50 The blades on the mixer are coated with uh, uh, with plastic or rubber so that when they bash into each other, they don't make any noise.
	BY THE 1960s, NEW DIGITAL TECHNOLOGIES CREATED PASSIVE SONAR, A HEIGHTENED ABILITY TO PICK UP OCEAN SOUNDS FROM HUNDREDS OF MILES AWAY. BY REDUCING A SUB'S AMBIENT NOISE, DISTANT SIGNALS BECAME CLEARER. COMPUTERS WERE THEN USED TO ENHANCE, SIFT AND CLARIFY THE INCOMING SOUNDS.

	<p>Mark Henry (53632) 16:06:43 In submarine warfare vs. submarine warfare, it is essential that you hear the enemy before he hears you. There are two ways to ensure that. One is to have a quieter submarine than he has. Put less energy into the water. And also to have a better sonar system than he does. To hear him before he hears you.</p>
	<p>THE NEW SILENCING AND LISTENING TECHNIQUES WERE INCORPORATED INTO THE NUCLEAR ATTACK SUBMARINE, USS THRESHER, LAUNCHED IN JULY OF 1960.</p>
	<p>Mark Henry (53632) 16:09:26 To improve the passive sonar system in Thresher, the entire bow was dedicated to sonar arrays. 16:10:12 The bow of the submarine is the quietest place on the submarine, which permitted the sonar to pick up fainter acoustic energy in the water than it would have otherwise.</p>
	<p>THE NEW SUB COULD LOCATE AND SHADOW SOVIET NAVAL FORCES VIRTUALLY UNSEEN. BUT THEN CAME A TRAGEDY.</p>
	<p>Sot: "With great regret and sadness, that this ship with 129 fine souls aboard is lost."</p>
	<p>AT 7:47 P.M. ON APRIL 10, 1963, THRESHER BEGAN A DEEP DESCENT 200 MILES OFF THE COAST OF BOSTON. AT 9:13 P.M. THRESHER RADIOED THAT SHE WAS HAVING DIFFICULTIES. AFTER SEVERAL MINUTES THE BOAT BEGAN DIVING. RADIO OPERATORS HEARD THE SUB BREAKING UP AS IT REACHED CRUSH DEPTH.</p>
	<p>Tom Clancy (53475) 02:00:52 When you get a hull rupture in a submarine, uh,</p>

	<p>the rapid change in the air pressure is essentially the reverse of what happened when they blew the ballast tanks. The air ignites. As so they're, everybody is flash-fried in a matter of seconds.</p>
	<p>ONCE THE OUTSIDE WATER PRESSURE CRACKED THE HULL, THE SUB'S INTERNAL ATMOSPHERE BEGAN TO IMplode CAUSING THE AIR AND GASES TO HEAT UP UNTIL THERE WAS AN EXPLOSION. THE DESTROYED SUB SETTLED ON THE OCEAN FLOOR AT A DEPTH OF 8000 FEET. A LATER INVESTIGATION CONCLUDED THAT INTERNAL LEAKING HAD LED TO THE SHUTDOWN OF THE REACTOR. THE SUB THEN TRIED TO BLOW HER EMERGENCY BALLAST TANKS BUT COULDN'T BECAUSE OF FROZEN PIPES.</p>
	<p>Dr. Norman Friedman (53628) 07:26:40 Thresher was the most advanced sub we'd ever built. And it was almost unthinkable that it would sink.</p>
	<p>LUCKILY THRESHER'S NUCLEAR REACTOR DID NOT BLOW UP FROM UNDERWATER SURFACE PRESSURE EXCEEDING 500,000 POUNDS PER SQUARE FOOT. THE NAVY'S CONTAINMENT AND SHIELDING DESIGNS PROVED SUCCESSFUL AND THE REACTOR REMAINS ON THE OCEAN BOTTOM TO THIS DAY. RADIOACTIVITY AT THE SITE IS CONTINUALLY MONITORED AND IS SAID TO BE MINIMAL.</p>
	<p>Dr. Gary Weir (53642) 12:02:30 It survived that depth because of a combination of the metallurgy, the metal used, the thickness, and the shape...the closer it is to being spherical, the, the more</p>

	survivable it is because of the exertion, the way the pressure is distributed across the face of the containment vessel.
	BUT THE ACCIDENT SHOOK THE NAVY TO ITS NUCLEAR CORE. SOON AFTER, ADMIRAL HYMAN RICKOVER IMPLEMENTED A RIGOROUS INVESTIGATION AND A TORTUROUS INSPECTION SYSTEM FOR FUTURE SUB CONSTRUCTION.
	Mark Henry (53632) 16:12:21 The Submarine Safety system introduced a level of detail that had never been seen before. All wells were inspected. All materials were tracked - where they came from, how they were used, how they were treated, where they went in the submarine.
	NEXT, BESIDES THE STRICT TESTING AND INSPECTION OF MATERIALS AND MACHINERY, THE QUEST FOR SAFETY IS ALSO EVIDENT IN THE TRAINING AT THE U.S.' NAVAL SUBMARINE SCHOOL IN GROTON, CONNECTICUT.
	FACTOID: ON MAY 27, 1968, THE USS SCORPION SANK OFF THE AZORES. BESIDES THRESHER, IT IS THE ONLY U.S. NUCLEAR SUBMARINE EVER LOST.
	NUCLEAR SUBMARINES WILL RETURN ON MODERN MARVELS.
ACT FIVE	
	WE NOW RETURN TO NUCLEAR SUBMARINES ON MODERN MARVELS.
	THE BACKBONE OF THE U.S. SUBMARINE FLEET IS THE TRAINING GIVEN ENLISTEES AT THE NAVAL SUBMARINE SCHOOL IN GROTON, CONNECTICUT. EVERY SUBMARINER MUST FIRST TAKE CLASSES FOR ABOUT ONE YEAR IN

	TACTICS, NAVIGATION, ELECTRONICS, WEAPONS AND SONAR, AMONG OTHERS.
	Sot: "Let's show you how it's put together."
	Dr. Norman Friedman (53629) 08:24:04 Underwater it's kind of dangerous. There's a lot of water pressure. You're in a place with highly radioactive stuff that can kill you. Very important that you know what to do.....if you want to know how important the submarine school is, look at what happens to a navy that doesn't have one. That's the Russians. And if you look at the number of Russians who have been horribly mutilated by making mistakes on nuclear subs, you would tend to think that is a real good investment for an awful lot of Americans.
	ONE OF THE MOST CRITICAL PARTS OF SUBMARINE TRAINING IS MASTERING FIRE-FIGHTING. AN UNDERWATER FIRE, IF NOT HANDLED PROPERLY, CAN MEAN CERTAIN DEATH FOR THE CREW.
	Sound up: Fire training
	Dr. Gary Weir (53643) 13:05:31 It will consume oxygen and very, very quickly. If the fire spreads, it will consume oxygen quicker than the boat can replenish it and you'll all asphyxiate. So putting out that fire fast....is absolutely...critical.
	Sound up: More fire training drills
	TRAINEES ALSO REPEATEDLY PRACTICE ISOLATING, CONTAINING AND HALTING LEAKS IN FLOOD CONTROL DRILLS.
	Sound up: Flooding
	Admiral Kinnaird McKee (53637) 02:10:47 At very deep depth a very small leak is a big problem because it sprays water everywhere and it can cut a man in half.....And you have to deal very quickly. And because you're talkin' about a matter

	<p>of 30 seconds to a minute for a serious leak before it's completely outta hand and there's nothin you can do about it....it also sprays salt water all over all the electrical equipment that happens to be in that compartment. And if that's essential equipment, you've lost it.</p>
	<p>ENLISTEES PRACTICE REPEATEDLY AT THE SEVERAL DIVE AND DRIVE SIMULATORS THAT MIMIC THE SUBMARINE'S CONTROLS. THEY FACE EXTREME CONDITIONS SUCH AS AVOIDING DEPTH CHARGES, STEEP ASCENTS AND TAILING ENEMY SUBS. THE TRAINEES ALSO PERFORM ESCAPE DRILLS, WHICH SIMULATE THE CONDITIONS OF A SINKING SUB.</p>
	<p>Dr. Gary Weir (53643) 13:07:08 They have to be drilled constantly in these procedures so the reaction is almost knee-jerk. It's almost instant, intuitive, how to compensate for anything that takes place.</p>
	<p>AFTER ONE YEAR OF LAND STUDY, ENLISTEES THEN TRAIN ON SUBS AT SEA FOR AT LEAST EIGHT MONTHS TO GET THEIR DOLPHINS, THE INSIGNIA PROVING FULL CREW MEMBERSHIP.</p>
	<p>Sot: "Red Crown, Red Crown, come in."</p>
	<p>THOSE SEEKING PROMOTION TO OFFICER OFTEN RETURN TO SUB SCHOOL SEVERAL TIMES OVER A FIVE-YEAR PERIOD BETWEEN PATROLS AT SEA. THE U.S. RELIED HEAVILY ON THE STRICT TRAINING OF THEIR CREWS, SAFETY RESTRICTIONS AND ADVANCED TECHNOLOGY TO COMPETE WITH THE GROWING NUMBER OF SOVIET NUCLEAR SUBS, WHICH WAS ABOUT 10 PERCENT MORE THAN THE U.S. BY THE MID-1970s. TECHNICALLY,</p>

	SOVIET SUBS WERE ALSO REACHING NEAR- PARITY WITH THE U.S. THE AKULA, A SOVIET ATTACK SUB LAUNCHED IN 1975, ATTAINED SPEEDS OF 35 KNOTS SUBMERGED AND WAS EXTREMELY QUIET. THE UNDERWATER COLD WAR BEGAN TO HEAT UP ALL OVER THE GLOBE.
	Tom Clancy (53474) 01:13:42 Certain U.S. Navy submarines would penetrate into Soviet territorial waters on a regular basis to conduct inshore intelligence gathering operations. Doing all sorts of spooky things the Navy will probably never acknowledge... We regularly shadowed Soviet fleet operations and would go directly underneath their ships to take what they call hull shots, which is photographs of the bottom of a Russian ship....01:12:42 They were on a wartime footing all the time.
	THE MISSION OF THE U.S. ATTACK SUBS WAS TO OPERATE ON THE FAR FRINGES OF THE COLD WAR, TO CONFRONT SOVIET SUBS, SHADOW ENEMY SHIPS AND COLLECT INTELLIGENCE, SOMETIMES IN SOVIET PORTS.
	Admiral Kinnaird McKee (53636) 01:12:49 They could operate alone and unsupported in waters controlled by the enemy. I used to tell my skippers....if you get where you're goin' and you're not outnumbered and alone, you're in the wrong place. And uh, they could do that, and stay there for long periods of time, and collect signals intelligence, and visual intelligence.
	Tom Clancy (53475) The fast attack boats scared the crap out of people for the simple reason that they could get there without being seen, and, and, kill people without

	<p>being endangered themselves....Once upon a time in the 1980s, we wanted to send a message to the Russians. And so every US Navy submarine that was at sea, on patrol and was trailing a Soviet ship....at the same moment globally they activated their active radar and pinged their targets....02:08:47 We were trying to send a message to the Russians that we are here and there's nothing you can do about it.</p>
	<p>THE DEADLY GAME OF BLIND MAN'S BLUFF CONTINUED IN THE PITCH-BLACK RECESSES OF THE WORLD'S OCEANS. THEN IN 1982, THE SOVIET UNION UNVEILED A TRUE MONSTER OF THE DEEP - THE TYPHOON - A 568 FOOT LONG, 25,000 TON SUB WITH 20 BALLISTIC MISSILES CARRYING MIRV WARHEADS WITH A RANGE OF 6,000 MILES. IT CAME WITH DUAL HULLS, TWO REACTORS AND 24 TORPEDOES. IT REMAINS THE LARGEST SUBMARINE EVER BUILT AND IS STILL OPERATIONAL. BECAUSE OF ITS LONG-DISTANCE MISSILE RANGE AND THE EFFECTIVENESS OF U.S. SONAR TECHNOLOGY IN LOCATING SOVIET SUBS, THE RUSSIANS RETREATED INTO AN ARCTIC BASTION STRATEGY IN THE 1980s. THEY PLACED THEIR BALLISTIC MISSILE SUBS UNDER THE ARCTIC ICE NEAR THEIR HOME PORTS AND SURROUNDED THEM WITH ATTACK SUBS. THE TYPHOON'S FLAT-TOP SAIL DESIGN REFLECTED THE NEW TACTICS.</p>
	<p>Dr. Gary Weir (53642) 12:22:15 It needed to pop through the ice rather quickly, so it needed that kind of heavy, squat durability so it could come up through the ice effectively to communicate and to launch</p>

	its missiles.
	SINCE THE COLD WAR ENDED IN THE LATE 1980s, U.S. SUBMARINES ARE SWITCHING FROM A DUAL SUPERPOWER STRATEGY TO MORE COMPLEX TACTICS TO COPE WITH A CHANGING WORLD.
	<p>Dr. Gary Weir (53644) 14:17:14 The real mission questions now are for the attack boats. They're going through a complete redefinition of what their world is about. They're being tightly linked to battle groups now and they never were before....14:18:06 There is no longer a monolithic threat. The threat can come from anywhere, from an established country or from a terrorist group. And more often than not, it's going to come in shallow water, not in deep water because the countries we're talking about don't have deep-water capability.</p>
	<p>DUE TO STRATEGIC ARMS LIMITATION AGREEMENTS, THE U.S. AND SOVIET UNION HAVE HALTED CONSTRUCTION OF THEIR BOOMER SUBS AND DECOMMISSIONED SEVERAL OTHERS. BOTH SIDES CONTINUE TO BUILD AND IMPROVE THEIR ATTACK SUBS. BRITAIN, FRANCE AND CHINA ALSO CURRENTLY OPERATE THEIR OWN NUCLEAR SUBMARINES. BUT AFTER DECADES OF ENGINEERING DEADLINES, CHURNING PRODUCTION GOALS, AND A CONSTANT CRISIS ATMOSPHERE, THE U.S. AND SOVIET NUCLEAR SUBMARINE PROGRAMS HAVE STEPPED BACK TO A STANDOFF. THOUGH U.S. SUBS CARRY BETTER TRAINED CREWS AND MORE ADVANCED SONAR CAPABILITIES, THE FIREPOWER ON EACH SIDE IS</p>

	<p>ENOUGH TO END HUMANITY MANY TIMES OVER. THE FINANCIAL COSTS HAVE BEEN STAGGERING. FROM ROUGHLY MID-CENTURY, THE U.S. HAS SPENT NEARLY 800 BILLION DOLLARS ON ITS ATTACK AND BOOMER SUBMARINES. TO MANY COLD WARRIORS, THE MONEY WAS WELL SPENT, AT LEAST SO FAR.</p>
	<p>Admiral Kinnaird McKee (53638) 03:18:06 We didn't go to war. We never shot at them and they never shot at us. That's a real achievement....the peace dividend in the minds of most people was 'oh boy, we can abolish the armed forces and spend all this money on lots of other things.' The peace dividend was peace.</p>
	<p>THOUGH HUNDREDS OF THESE LETHAL SHAPES HAVE MOVED SILENTLY PASSED EACH OTHER IN THE OCEANS OF THE WORLD FOR DECADES, NO NUCLEAR WARHEAD HAS EVER BEEN LAUNCHED. BUT EVERYDAY, HUNDREDS OF FEET UNDER THE OCEAN'S SURFACE, A TWILIGHT CAT-AND-MOUSE GAME CONTINUES BETWEEN THESE HI-TECH BEASTS - TESTING, PROBING AND SHADOWING EACH OTHER FOR THE TIME WAR MAY COME - A WAR THAT WOULD SURELY END HUMAN CIVILIZATION.</p>
	<p>END</p>