

RIDING THE DD 963

BY

COMMANDER A. G. TROTTER, M.Sc., C.Eng., M.I.Mech.E., R.N.
(*British Navy Staff, Washington*)

Introduction

The author was invited to attend Acceptance Trials of the SPRUANCE or DD 963 Class ship, U.S.S. *Nicholson*, by the NAVSEA Project Team, and Commander Jim Regan, U.S.N. was his host for the visit which lasted for four days, 25–29 March 1979. The initial intention was for the author to accompany the INSURV (Board of Inspection and Survey) Team in a U.S. Navy plane from Andrews Air Force Base to Mobile but the plan was changed and he travelled with the Project Team by Delta and Eastern Airlines via Atlanta to Mobile and thence by rental car to Pascagoula, Mississippi, where the Ingalls Shipbuilding Division of Litton Industries is situated.

Ingalls and its Products

Ingalls shipyard was on the east bank only of the Pascagoula River until 1969 when a new construction facility was opened on flat ground on the west bank. Here, five LHA Class ships, thirty DD 963 Class, and four DDG 993 (originally for the Iranian Navy) have been built. *Nicholson* is number twenty of the DD 963s and number thirty was in the final stages before launch. The ships are built in three distinct hull sections and one superstructure section on railborne cradles and as the fitting out proceeds they move nearer the water's edge. The sections are joined and are launched by being transferred to a large pontoon sitting on a concrete grid on the seabed adjacent to the building area. After transfer, the pontoon is pumped out until it can float clear of the grid and then, in deeper water, it is re-sunk to leave the new hull completely waterborne. Construction is taken to a very advanced stage (70 per cent.) before launch, with engines, gearboxes, and all machinery fitted and shafting aligned at the west bank site. LHA hulls have weighed in excess of 25 000 tons when transferred from land to pontoon. Fitting out of the LHA is continued at the west bank site but the destroyers are taken to the east bank which is where *Nicholson* was berthed. Nine destroyers in line, at various stages of fitting out, is an impressive sight. Ships are moved through four distinct work stations to take advantage of the benefits of specialization.

The specification for the SPRUANCE Class ship was written in terms of performance—a policy imposed on the Department of Defense by Robert McNamara, Secretary of Defense during the Kennedy administration. This contract has produced an outstanding vessel although with some major problems. Many new and novel ideas were introduced by engineers uninhibited by tradition, but some pitfalls were suffered that a more conservative approach would have avoided.

A deliberate policy of allowing a large margin for growth has led to a spacious hull with many unassigned spaces and others with a lot of room around the fitted equipment. In contrast, a lack of appreciation of the importance of maintenance requirements has allowed machinery to be installed without adequate, or sometimes any, withdrawal space for inspection or clear routes for component or assembly changes. While the main propulsion gas generator and power turbine can be removed through the air intake, a change of auxiliary boiler tube nest requires a hole to be cut in the ship's side.

Main propulsion equipment was shore tested at the Naval Ship Engineering Center, Philadelphia, and performs well in the fleet. The auxiliary machinery has,

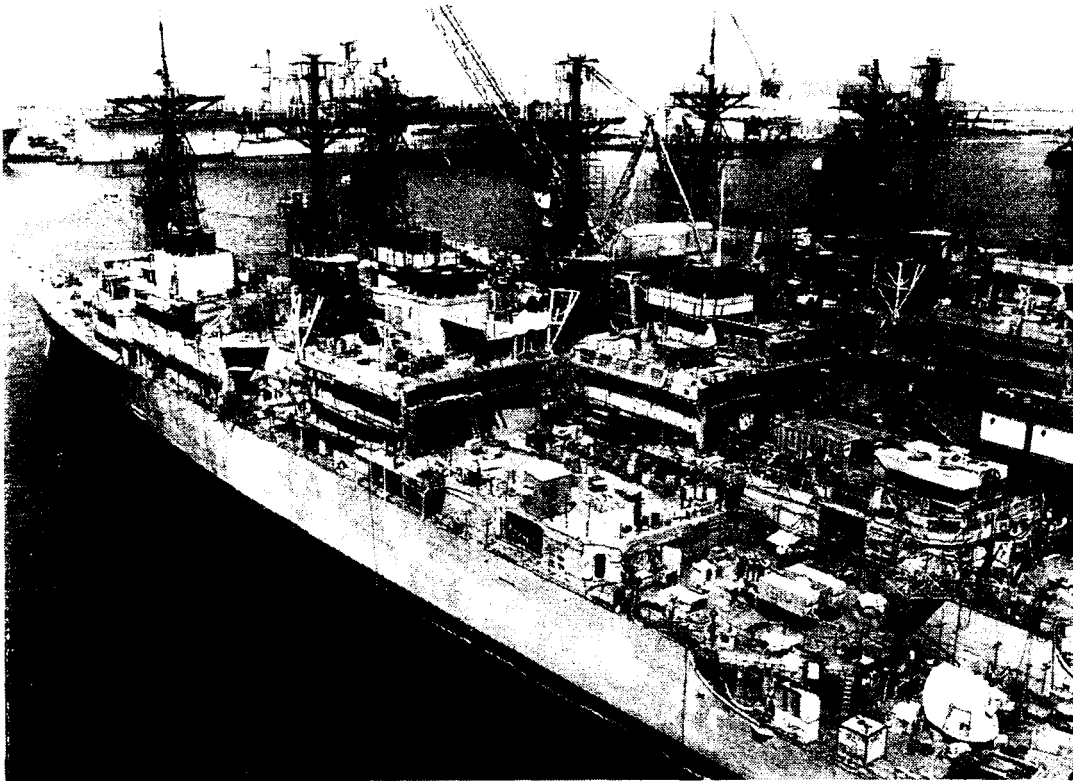


FIG. 1—INGALLS SHIPYARD—FITTING OUT AT THE EAST BANK SITE ON THE PASCAGOULA RIVER

however, caused the main problems. Careful attention has been given to noise reduction, attenuation, and isolation, and this has produced a ship with low underwater noise. The use of gas-turbine generators instead of diesels, masker air, attenuation mounts for the main gearbox, and close tolerancing of coupling alignments are some examples of the means to achieve this¹.

Shore testing of all electronic equipment has been a technique used to reduce setting to work time. Cabinets, grouped on pallets and wired together, are installed as a complete unit to minimize the number of connections to be broken and remade after shore test².

The learning curve was reportedly a long one but the standard observed during the acceptance trial is now high. The ship was spotlessly clean. There were few defects and none that delayed the steady progress of individual trials. All personnel onboard were enthusiastic and helpful and showed competence, pride in their product, and confidence in its high standard, while being frank about its shortcomings.

The Trial

A trials handbook produced by the shipbuilder listed the trials together with the time schedule, event number, agenda number, and the names of the responsible engineer, naval architect, and operations officer. TABLE I in the appendix to this article lists only the time, event number, and description of each trial. During the trial, the author spent some time in the Central Control Station (CCS), visited all the machinery spaces and met many of the personnel onboard.

Rear-Admiral J. Bulkeley, the President of the Board of Inspection and Survey, was expected to attend the trial but was detained in Washington to give evidence at a Congressional hearing—an activity that influences the actions and takes much of the time of senior officers in the U.S. Navy. Mr. L. Erb, the President of Ingalls Shipbuilding, was onboard during the trial.

Just twenty-four hours was spent at sea and four hours of this was at full power. As the ship was clean and light, not having embarked all its stores and,

in any case, being well below its final displacement with all systems fitted, full power and design torque was only achieved by using more than design pitch. In service, an annual check is required at full shaft speed and design pitch. At full power the ship was impressive, noise was not excessive in machinery spaces and quite acceptable in accommodation areas. Vibration was barely detectable and even in the stern was very low except during high speed turns and crashback manoeuvres as would be expected.

Habitability standards are higher in this ship than in any other U.S.N. vessel. Furnishings and decor are light and modern. Metal and plastic materials are universal—not one piece of wood was seen onboard. Crew mess-decks are spacious with direct access to showers and bathrooms. All food onboard is prepared in one central galley and, judging by that served on trials, would be of high standard.

Each space in the ship has its own air-treatment unit with an electric heater and a chiller supplied with chilled water from a central point. A space thermostat operates each as required. The air in the space is changed by a small make-up supply with exhaust to main passageways, and the air is circulated by a very quiet low-speed fan in the unit. The unit measures approximately 3 ft × 3 ft × 6 in, and is mounted high in the compartment. Since deck-to-deck height averages 8 ft 6 in, there is no restriction to the specified 7 ft 6 in overhead clearance. The absence of large air trunks and air and fan noises made a major contribution to the feeling of comfort in the ship, but distributing uncooled humid air within the hull has led to some condensation problems. A combination of this and the R.N. system may be the ideal. The ship's side is not lagged in machinery spaces and this could also cause temperature and humidity problems. Chilled water for electronic units is supplied from a separate source, and a recent problem has been condensation inside cabinets due to overcooling, especially when compartment temperatures have been set high.

U.S. Trial Arrangements

As an ex-Machinery Trials Unit Officer, the author found the organization and method of conducting trials particularly interesting. Three formal trials are conducted. Firstly, a Builder's Trial (BT) at which Navy personnel merely observe the actions of the contractor's personnel in proving the readiness of the ship for presentation and acceptance. The Acceptance Trial (AT)—about two weeks after the Builder's Trial—is conducted by the shipbuilder to INSURV requirements, and is witnessed by representatives of INSURV, SUPSHIPS, and Ingalls. SUPSHIPS, the Supervisor of Shipbuilding Conversion and Repair, is the equivalent to our Principal Naval Overseer but his organization is more fully involved than are the overseers in R.N. sea trials. The ship's company do not get involved in the dockside tests and trials, setting to work, or operation during sea trials, but the Fleet Introduction Team carry out many compartment inspections and attend auxiliary machinery trials during the final stages of build, reporting results to SUPSHIPS. At the time of acceptance trials, the Commanding Officer, Chief Engineer, Main Propulsion Assistant, and some senior enlisted men have joined but the remainder do not arrive for a further two weeks. They then carry out a training and familiarization programme under the direction of the Fleet Introduction Team who are based at the shipyard for this task. This team is headed by a captain who was the Commanding Officer of the first ship of the Class.

After return from trials on Day-2, INSURV analyses results and defects and then specifies items to be opened for examination. Overnight, the shipbuilder opens equipment and records all alignments and clearances required by INSURV so that Day-3 can be spent examining gears, bearings, seals, valves, and filters and discussing corrective measures to be taken. The trial is completed on Day-4 after a listing of defects and a post-trial conference.

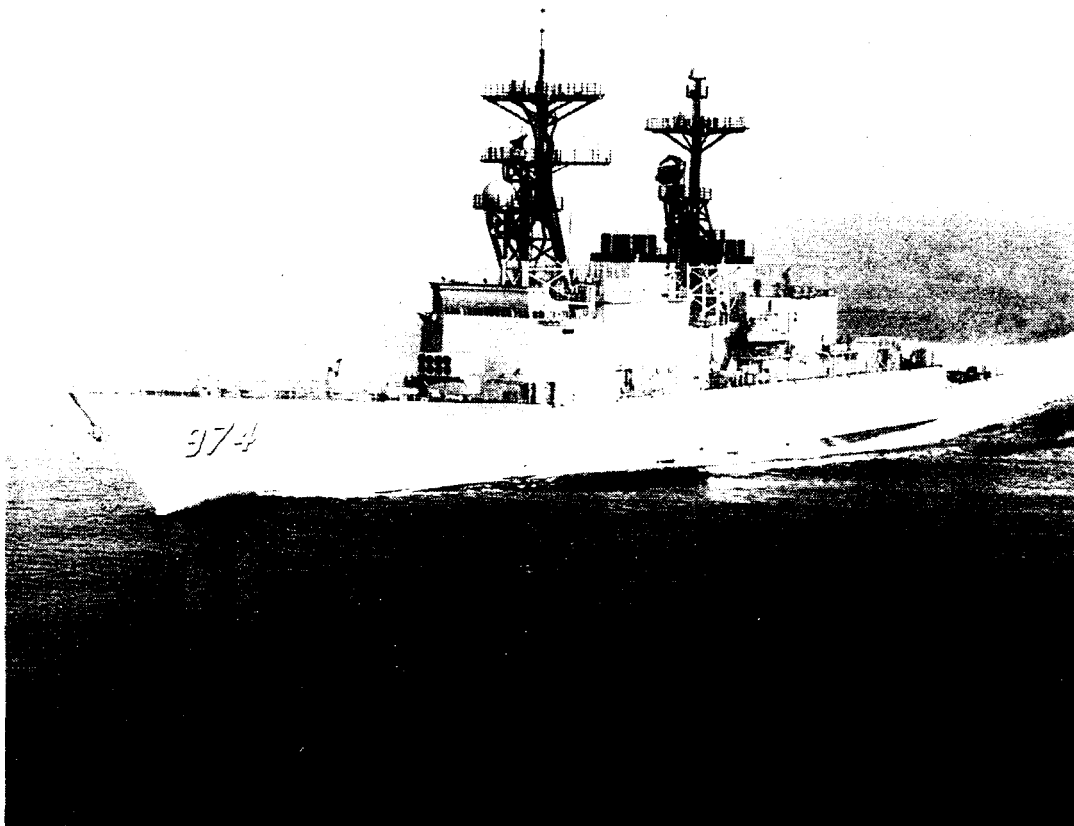


FIG. 2—U.S.S. 'COMTE DE GRASSE'

After two weeks of training, the ship is accepted and then, after a further three weeks, it is taken by the Navy crew to its base port. This particular ship will be based in Charleston, South Carolina. After a further three to six months of training and trials, a Final Contract Trial (FCT) is conducted by the ship's company and INSURV and defects are recorded. The ship then returns to the contractor for a Post Shakedown Availability (PSA) for correction of any defects discovered during this period. The warranty period continues until twelve months from the date of acceptance.

Weapon Additions

While INSURV were working on trial results on Day-2, the author accompanied members of the Project Team on an inspection of U.S.S. *O'Bannon*, hull number DD 987. During the design of the Class, some desirable weapon systems were still in development. Instead of specifying fully-developed but less advanced systems, spaces were left for retrofitting. *O'Bannon* is the first to receive these backfits during build and will enter service with Harpoon and Sea Sparrow weapon systems together with many other improvements and alterations.

Earlier vessels will receive these additions and alterations during Restricted Availabilities (short refits) at U.S. Navy shipyards or during extended Post-Shakedown Availabilities at Ingalls shipyard.

The most impressive aspect of this short tour was the ease with which one moved around the vessel. All welding cables and air lines were routed through overhead cradles and decks were completely clear and clean. The aluminium superstructure is joined to the steel hull using a transition strip consisting of a direct aluminium-to-steel joint which is made by an explosive bonding process. Joinery bulkheads consist of aluminium honeycomb between aluminium sheets

faced with plastic easy-to-clean surfaces. In pipe systems, flanges are kept to a minimum by using welded or brazed joints.

Conclusion

This vessel caused many problems during conception, birth, and adolescence but, when the necessary modifications are complete, the U.S. Navy will have a quiet, comfortable, fast, and powerful warship which still has the potential for further growth and modernization.

References:

1. Rains, D. A., 'DD 963 Power Plant marine technology', January 1975.
2. Duke, W. L., 'DD 963 Class Combat System Installation and Testing', *Marine Engineers Journal*, February 1979.

TABLE I—*Trial programme*

First day of trial (in port)

<i>Time</i>	<i>Event</i>	<i>Description</i>
0700	1	Conduct an underwater inspection of the sonar dome, air emitters and propellers.
0800	2	Start two S/S GTGs and assume electrical load. Test standby S/S GT generator automatic paralleling capability and reverse power relays. Conduct tests on 60 Hz Power Distribution board and system. Manually operate all electrically-operated generator and bus tie circuit breakers. SUPSHIP to certify satisfactory demonstration of the above capability to INSURV upon arrival onboard. On completion, insure GTGs are set up for split plant operation in preparation for the trial.
0800	3	Inspect mast and guards for tools or miscellaneous gear. DO NOT RADIATE RADAR OR RADIO TRANSMITTER DURING MAST INSPECTION.
0800	4	Demonstrate Hull Equipment Hardware: (a) Sonar Boom Rigging (c) Ship's Brow (b) Leadsman Platform Rigging (d) Ship's Gangway
0900	5	Test the general, chemical, and collision alarm systems and the ship's whistle.
1000	6	Conduct the Surveillance and AIMS Functional Demonstration.
1000	7	Supervisor of Shipbuilding, Pascagoula, inspect trial documents, safety and health facilities. Safety and Health items to include: Life boats are operational and outfitted for safety at sea. Inflatable life boats have been inspected and are properly stowed. Life rings and float lights are in stowage brackets. Life jackets are in the amount of one hundred and five per cent. of embarked personnel. Inspect personnel transfer at sea (stokes) litter as provided by SupShips, Pascagoula. Adequacy of fire, abandon ships, and general emergency bills. Sufficient OBAs, shoring, and fire extinguishers are onboard and stowed, and fire stations are equipped for use. Review results of bacteriological test and chemical analysis of potable water. Medical Kit and Medical Representative is scheduled for trial. Inspect for sufficient quantities of lube oil, feed water, potable water, and fuel oil.
1000	8	Demonstrate GTM overspeed trips for one engine room to SupShips.
1100	9	Test main lube oil pressure alarms, governors and automatic shifting devices in one engine room to SupShips.
1100	10	Demonstrate Underway Replenishment System: (a) Forward Retractable Kingpost (b) Aft. Retractable Kingpost

<i>Time</i>	<i>Event</i>	<i>Description</i>
1100	11	Start Gyro Compass.
1100	12	Energize electronics equipment.
1100	13	Conduct Radio Communication System Functional Demonstration.
1100	14	Conduct Electronic Navigation System Functional Demonstration.
1100	15	Commence the Command and Control Subsystem Demonstration.
1100	16	Confirm aircraft services with SupShips.
1200		INSURV Board and Supervisor of Shipbuilding, Pascagoula arrive onboard. Conduct pretrial conference in the wardroom.
*	17	Conduct pre-underway firefighting and damage control equipment check as requested by Trial Board Member.
*	18	Demonstrate the package conveyor system.
*	19	Commence over-the-side torpedo handling.
*	20	Operationally demonstrate the portable fire (P-250) and electric submersible dewatering pumps.
*	21	Conduct a simultaneous anchor handling demonstration.
*	22	Conduct the CO-2 life boat test and inspection.
*	23	Demonstrate the shop equipment.
*	24	Demonstrate boat handling for the outboard boat.
*	25	Demonstrate the galley fixed APC system.
*	26	Commence the weapons system alignment demonstration.
*	27	Demonstrate the WQC-2 underwater telephone.
*	28	Test main lube oil pressure alarms, governors and automatic shifting devices in the engine room not demonstrated to SupShips.
*	29	Test emergency power bus transfer and alarm circuits, steering gear and associated circuits and console. Demonstrate bridge wing remote steering unit.
*	30	Demonstrate GTM overspeed trips in the engine room not shown to SupShips.
*	31	Demonstrate the VHF bridge-to-bridge radio.
		* Upon arrival of the INSURV Board and SOS, Pascagoula.
1500	32	Record tank soundings.
1500	33	Start main engines and test control systems in preparation for underway operation.
1500	34	Energize navigation equipment.
1500	35	Start sewage treatment plant in incinerator mode.
1500	36	Start L.P. and H.P. compressors in automatic mode, to remain in operation throughout the trial.
1530	37	Read and record ship's draft.

First day of trial (at sea)

<i>Time</i>	<i>Event</i>	<i>Description</i>
1600	38	Depart Pascagoula for trial area.
1600	39	Demonstrate GTM throttle control from ship's control console.
1600	40	Demonstrate the following non-electronic navigation equipment. (To continue throughout the trial): (a) Wind direction and speed equipment. (b) Main and auxiliary gyro compasses. (c) Magnetic compass. (d) Dead reckoning system.
1600	41	Check the AN/SPS-40B and AN/SPS-55 radars for optimum tuning using targets of opportunity. Demonstrate AN/SPS-55 during piloting operations.
1600	42	Commence the operational demonstration of the electronic navigation system.
1600	43	Conduct the announcing system demonstration concurrent with announcing trial events.
1600	44	Commence the radio communication operational demonstration.

<i>Time</i>	<i>Event</i>	<i>Description</i>								
1600	45	<p>Commence the general hull inspection to include:</p> <p>Inspect all accessible compartments and examine structure for marked distortion, unfairness, or evidence of weakness such as buckled members or cracked welds.</p> <p>Inspect for interference such as doors or hatches that do not open fully, valves that cannot be operated, or obstructions in passageways. Supply Department spaces and store rooms. Conduct an inspection of the stowages for test equipment as required by the Trial Board Member.</p> <p>Weather deck preservation, life lines, and stanchions. (Heavy weather life lines to be rigged.) Demonstrate bulkhead-mounted sliding padeyes and refuelling stations.</p> <p>Inspection of navigation and operation spaces to determine status of spaces relative to size, ventilation, air conditioning, lighting, etc.</p> <p>Habitability inspection of living and messing spaces.</p>								
1600	46	<p>Conduct Damage Control Inspection to include:</p> <ol style="list-style-type: none"> (1) Damage Control repair stations, equipment, and damage control spaces. (2) Firemain and fire stations throughout the ship. (3) Watertight fittings, closures, and fitting classifications throughout the ship. (4) Damage Control software, e.g. compartment checklist and damage control plates and diagrams. (5) 125 lb dry chemical extinguishers in the auxiliary machinery rooms, windlass room, and steering gear room. (6) Portable 18 lb dry chemical extinguishers throughout the ship. (7) Portable 15 lb CO₂ extinguishers throughout the ship. (8) Fixed CO₂ system in flammable liquid storerooms, paint mixing room, gas turbine enclosures, and ship's service generator gas turbine enclosures. Demonstrate the function of the ventilation cut-off switches, alarm systems and lights, and operability of the remote actuating devices. <p>Inspect the environment control system including ventilation ducting. Note evidence of excessive noise or vibration, blowers or ducts discharging into electrically sensitive areas. Check for maintenance of proper temperatures of spaces by operation of heating, ventilation and/or air-conditioning systems with correct thermostat setting.</p> <p>Medical/sanitation inspection of food service areas. Equipment operation and inspection including battle dressing stations, decontamination stations, and sanitation facilities. Inspect medical equipment and spaces.</p> <p>Machinery spaces:</p> <ol style="list-style-type: none"> (1) Vibrating of machinery operating spaces. (2) Illumination of machinery operating spaces. (3) Relative noise levels in machinery spaces. Workability of communications system with machinery in operation. (4) Accessibility of valves and controls under floor plates, in overhead, and from operating platform. (5) Adequate space ventilation. (6) Efficiency of design and construction with regard to efficient and logical arrangement, adequate headroom, and access for repair, maintenance, and replacement of machinery units and associated components. 								
1600	47	Inspect the helicopter facilities and equipment including flight-deck lighting. Demonstrate JP-5 stowage and transfer system.								
1600	48	Demonstrate the ship's entertainment system.								
1600	49	<p>Demonstrate the following equipment in conjunction with meal preparation:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Refrigeration equipment</td> <td style="width: 50%;">Galley and ice cream bar equipment</td> </tr> <tr> <td>Trash compactor</td> <td></td> </tr> <tr> <td>Scullery equipment</td> <td>Dumbwaiter</td> </tr> <tr> <td>Garbage disposal equipment</td> <td>Wardroom pantry equipment</td> </tr> </table>	Refrigeration equipment	Galley and ice cream bar equipment	Trash compactor		Scullery equipment	Dumbwaiter	Garbage disposal equipment	Wardroom pantry equipment
Refrigeration equipment	Galley and ice cream bar equipment									
Trash compactor										
Scullery equipment	Dumbwaiter									
Garbage disposal equipment	Wardroom pantry equipment									
1600	50	Commence demonstration of the magazine protective system.								

<i>Time</i>	<i>Event</i>	<i>Description</i>
1630	51	Commence AWHs/MK 16 Launcher group functional demonstration.
1700	52	Commence torpedo handling and strikedown gun ammunition and missile handling demonstration.
1700		Ship clear Horn Island.
1700	53	Lower the underwater log. Demonstrate the underwater log equipment.
1700	54	Demonstrate the pilot ladder. Disembark pilot.
1700	55	Demonstrate emergency throttle takeover capability.
1700	56	Proceed to 20–25 knots and check CPP propeller pitch alignment, align if required. Drag shaft on completion.
1700	57	Commence SSW operational demonstration on targets of opportunity.
1700	58	Demonstrate the drainage system.
1730	59	Demonstrate the air-conditioning plants.
1730	60	Commence the distilling plant 8-hour capacity test upon plant stabilization.
1730	61	Inspect the I.C. switchboards and systems. Test a representative number of I.C. circuits.
1730	62	Propulsion shaft bearing inspection. Will continue throughout the trial.
1730	63	Commence underwater surveillance demonstration.
1830	64	Commence MK 86 GFCS functional demonstration.
1900	65	Demonstrate the ship's monorail system.
1900	66	Demonstrate the radiation monitoring system.
1900	67	Demonstrate the storage battery charging equipment.
1900	68	Demonstrate the navigation and signalling lights and the IR signalling light.
1930	69	Commence the four (4) hour full power run.
1930	70	Conduct heat stress and ambient noise survey of engineering spaces. Also conduct a test for carbon monoxide gas in the vicinity of generator and main propulsion turbine exhaust ducts.
1930	71	Test darken ship switches and conduct darkened ship survey. Also, inspect underway replenishment and general interior illumination.
1930	72	Commence 5"/54 gun system functional demonstration.
1930	73	Commence degaussing system demonstration.
1930	74	Demonstrate the brominator recirculating system.
1930	75	Demonstrate the classified waste disposal system.
1930	76	Demonstrate the ship's refrigeration system.
1930	77	Commence TTM/THS and torpedo door functional demonstration.
2000	78	Commence AAW—GFCS 86 operational demonstration.
2130	79	Commence listening test on main propulsion machinery and reduction gears.
2130	80	Observe interior communications in main machinery spaces.

Second day of trial (at sea)

<i>Time</i>	<i>Event</i>	<i>Description</i>
0000	81	Inspect main lube oil strainer and draw lube oil samples from main reduction gears.
0000	82	Commence ahead steering and power failure test.
0100	83	Conduct quick reversal ahead to astern.
0115	84	Conduct astern steering and power failure test.
0200	85	Commence MK 116 UFCS functional demonstration.
0215	86	Commence half-hour full power astern run.
0300	87	Conduct quick reversal astern to ahead.
0300		Shift sewage plant to mascerator mode.
0315	88	Drag shaft.
0330	89	Demonstrate shaft locking.
0430	90	Commence Sonar self-noise measurements. Observe Prairie/Masker operation.

<i>Time</i>	<i>Event</i>	<i>Description</i>
0630	91	Demonstrate the NIXIE countermeasures set.
0730	92	Commence the reduced capability (SOP) ASROC attack.
0730	93	Demonstrate the laundry equipment.
0830	94	Commence STS demonstration (Sonar active).
0830	95	Demonstrate the ASROC security alarm.
0930	96	Commence anchor handling and stowage demonstration.
0930	78 (Cont.)	Continue AAW-AN/SPS-40 long haul and UHF radio communications demonstration.
0930	97	Commence AFFF demonstration.
0930	98	Commence BVP/AIMS demonstration with jet aircraft.
0930	99	Commence the damage control console demonstration.
0930	100	Demonstrate the impressed current cathodic protection system.
0930	101	Demonstrate land line termination.
0930	102	Demonstrate the hot and cold water system.
0930	103	Demonstrate the waste heat boilers.
0930	104	Demonstrate the Degaussing System.
0930	105	Continue the torpedo handling and strikedown, gun ammunition, and missile handling demonstration.
1130	106	Commence boat handling and stowage demonstration for the boat not demonstrated dockside.
1130	107	Demonstrate the 400 Hz power converter system.
1230	108	Commence countermeasures washdown system operational demonstration.
1230	109	Commence I.R. suppression system.
1230	110	Commence fuel control console and tank level indicating system demonstration.
1300	78 (Cont.)	Commence AAW (back-up, if required).
1300	111	Commence auto pilot demonstration.
1400	112	Commence MK 86 GFCS balloon-borne target tracking.
1400	113	Commence ASW operational demonstration.
o/c	114	Arrive sea buoy and raise underwater log.
**	115	Shift sewage plant to incinerator mode.
**	116	Demonstrate 'no break' power supply feature, of selected equipment, to INSURV Board. Demonstrate gas turbine generator overspeed tripping devices, reverse power relays, and automatic paralleling capabilities.
**	117	Demonstrate the mooring capstans during docking operations.
**	118	Read and record ship's draft.

Second day of trial (in port)

<i>Time</i>	<i>Event</i>	<i>Description</i>
**	119	Secure the sewage plant treatment.
**	120	Open and inspect machinery, tanks, and voids as requested by Trial Board Member.
**	121	Inspect the underway replenishment system and facilities.
***	122	Continue reference standard checks of electronic equipment.
***	123	Conduct the Sonar dome pressurization demonstration.
***	124	Inspect Sonar dome.
***	125	Conduct mast and antenna inspection.
***	126	Continue torpedo handling and strikedown, missile and gun ammunition handling and stowage demonstration.
***	127	Demonstrate the hull equipment hardware as requested by Trial Board Member.

** Upon arrival at Ingalls.

*** Will be scheduled as directed by Trial Board Member.