PROJECT HULVUL
CHEMICAL DEFENCE TRIALS

BY

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ABSTRACT

Chemical defence trials in H.M.S. *Naiad* measured the effectiveness of prewetting in minimizing weatherdeck contamination and vapour ingress into the Citadel, and also studied the effect of a Citadel breach.

Introduction

Hull vulnerability trials are being undertaken in the old LEANDER Class frigate H.M.S. *Naiad*. Some 50 trials have been planned, covering NBCD, fire, shock, whipping, blast and fragmentation.

FIG. 1—H.M.S. 'NAIAD' IN POSITION FOR THE TRIAL

The NBCD and fire trials are now complete, and this article covers those concerned with Chemical Defence (FIG. 1). The trials were planned and carried out by staff of the Chemical Defence Establishment (CDE), Porton Down, with the valuable assistance of ship's staff. Full reports are being written and this article will therefore deal mainly with the trials procedure and also give some initial conclusions.

The aims of the trials were:

(*a*) To measure the effectiveness of the prewetting system in reducing weather deck contamination and to measure levels of vapour ingress into the Citadel.

(*b*) To study vapour movement and levels within the Citadel after a breach.

Preparations

In preparation for the trials, all Citadel boundary defects were made good, new Air Filtration Units fitted and a satisfactory Citadel Test carried out. A Citadel overpressure of 2·5 inches water gauge was achieved during the test and maintained throughout the trials, except when the Citadel was breached.

Bulkheads at 27 and 49 frame stations were made gas-tight as far as possible, the object being to enable the ship to be divided into three gas-tight zones during the later stages of the trials (FIG. 2).

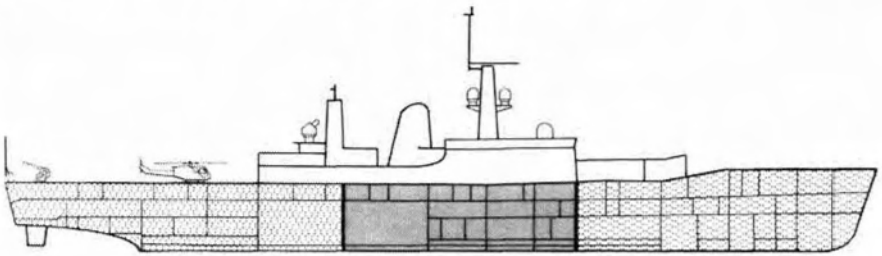

FIG. 2—GAS-TIGHT ZONES FOR TRIALS IN H.M.S. 'NAIAD'

The ships prewetting system was made fully operational and the designed pressure of 100 lb/in^2 achieved.

For safety reasons it was necessary to carry out the trials well away from shore. The ship was towed to a mooring some two miles off shore between Portsmouth and the Isle of Wight. Trials staff were taken by boat to the ship each day. The trials were carried out between 11th and 29th July 1988, with a small supplementary trial on 17th and 18th October 1988.

Contamination Simulation Outside the Citadel

For contamination of the weather decks the chemical simulant used was methyl salicylate (MS), a simulant for Mustard Agent, in both thickened and unthickened forms. The simulant was disseminated by Simulator Projectile Airburst Liquid (SPAL) (FIG. 3). SPAL is frequently used for training and trials on land but had not previously been used at sea. It is basically a simple mortar with a launch tube and projectile. The liquid is contained within a one litre bottle and bursts some 30 metres above the firing position. SPAL launchers were positioned as follows:

port and starboard	foc's'le
port and starboard	forward of Ikara
port and starboard	below bridge
port and starboard	base of foremast
port and starboard	top of ladder 01/02 decks
centreline	forward of funnel

The base of each SPAL was held to the deck by magnets. By means of circular wedges angled at either 5°, 10° or 15° it was possible to angle the launch of SPAL into wind and forward of the ship, allowing the simulant

to drift back over the ship. The total amount of MS for each firing was approximately 10 litres with the aim of giving an average contamination density over the ship of about 5 g/m^2. The position of the ship during the release of SPAL was important; a tug was used to pull the stern of the ship so that the wind was 10–15° off the port bow. A preliminary firing of SPAL was needed to determine the correct angle for the launch tubes.

FIG. 3—SPAL IN USE FOR DISSEMINATION OF CHEMICAL SIMULANT

Contamination Simulation Within the Citadel

MS was also used as the simulant inside the Citadel and was dispersed by aerosol cans. All of the simulant was dispersed within 30 seconds from a central position in the Citadel.

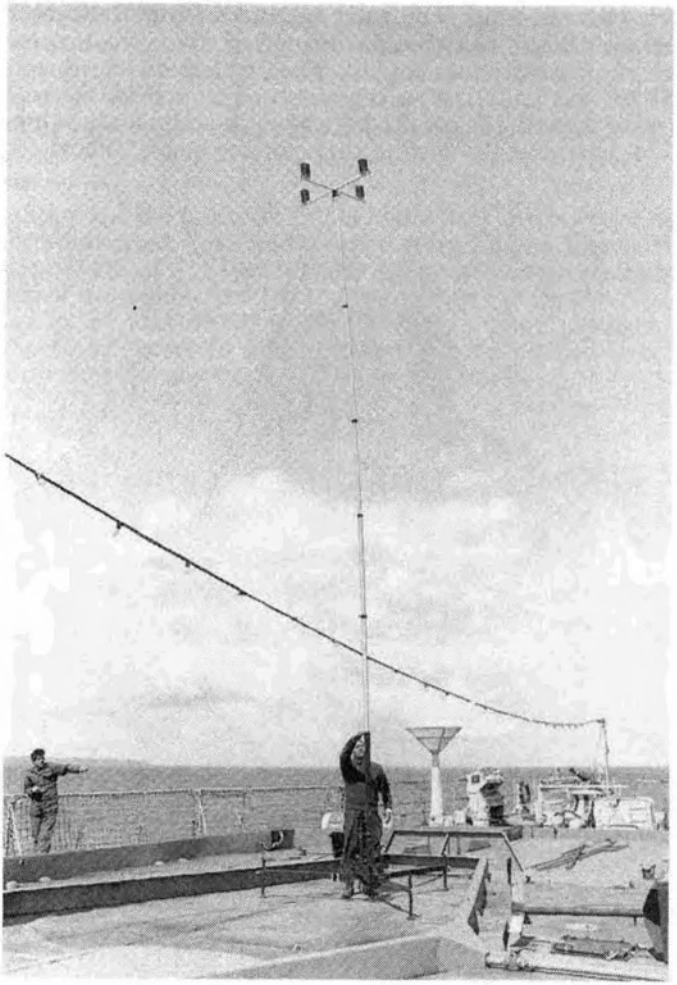

FIG. 4—HIGH LEVEL SAMPLING EQUIPMENT

Contamination Density Measurements and Vapour Sampling

There were 48 positions around the weatherdecks for sampling liquid contamination. To sample above the prewetting, five telescopic masts (FIG. 4) were positioned along the centreline of the ship from stem to stern. At the top of each mast was a crosshead with vertical and horizontal sampling felts. To recover any liquid contamination reaching deck level whilst the prewetting was operating, a simple 'rain gauge' was used, held to the deck by magnets. Where the prewetting was to be operated some time after arrival of the contaminant, circular polyester sampling felts were substituted for the rain gauges.

Small battery-operated pumps fitted with adsorption tubes sampling at a nominal one litre per minute were placed around the weather decks and throughout the Citadel. Several Chemical Agent Monitors (CAM) were used throughout the trial to record vapour levels (FIG. 5).

FIG. 5—CONTAMINATION MONITORING

Meterological Records

A Meteorological Officer was present for all trials and a full Met. record kept. Wind speeds were generally in the range 4–7 m/s (10–15 knots). Air temperatures were between 17° and 25°C. Deck temperatures varied between 14° and 21°C when wet and between 24° and 48°C when dry. Relative humidities ranged from 61% to 80%.

Summary of Trials Results

1. SPAL can be deployed successfully to contaminate a ship for trials.
2. The Chemical Agent Monitor (CAM) proved effective in highlighting residual contamination.
3. The intact, pressurized Citadel was effective in preventing the ingress of vapour from a liquid challenge.
4. A small breach of the Citadel, about 0.2 m^2 representing one shell hole, caused an almost complete loss of overpressure. Although no ingress of vapour was detected by CAM, very low levels of vapour concentrations were detected by the sampling equipment.
5. Air movement in a LEANDER Class frigate is from forward to aft (towards the air bleed valves in the Cleansing Station), therefore the safest place after internal contamination is forward of the breach.
6. The Citadel in a LEANDER Class frigate cannot be subdivided without major modification to ventilation systems.
7. Internal release of vapour, representing a major breach, showed that significant vapour concentrations remained within the Citadel for at least two hours.
8. Liquid contamination passed freely through the spray of the prewetting system but the system, whether used in the Pre- or Post-Wetting mode was effective in removing most contamination from the main areas of the weatherwork and weatherdecks. Many typical 'hotspots' and types of material where contamination remained have been identified.

9. The trial of low-level sprays was satisfactory, although the 'pop-up' sprayheads failed to retract on completion of prewetting.

10. CAM readings taken during the weathering trial (without use of the Prewetting System) indicated that all exposed areas of the weatherdecks were clear of vapour after about 5 hours.