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20/1/87

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Reference: SDE/PFG/105/07
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16 January 1987

TCHD ACCIDENT - WEST DEAN, 10.1.87



AWRE View

Summary

This report outlines the detail of the accident as interpreted by DA staff. It is the DA's opinion that all of the four weapons involved remained safe and serviceable with respect to the elements for which AWRE has design responsibility.

This is supported by Chairman/WSCC and endorsed by D/AWRE.


 SDE/AWRE  16/1/87


 HWE/DA WE 177  16/1/87

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1. BACKGROUND - THE ACCIDENT

A convoy was in transit from RNAD Frater (Portsmouth) to Dean Hill as part of routine Naval transfers of WE 177As. This had four TCHDs in total, one of which was the empty 'spare' vehicle.

One of the TCHDs containing two WE 177As was edging past a car coming in the opposite direction, with his near side wheels on the verge, when what appears to be a subsidence occurred and the vehicle toppled sideways into a cornfield which was now stubble and frozen. The slow speed of this can best be judged by the driver being able to report what was happening to the Convoy Commander over his communication system, and what is more repeat it during the process.

The vehicle immediately behind was another loaded TCHD which was taking essentially the same line. He stopped with his front wheels off road, straddled on the front axle, but with the near side rear wheels on the verge.

In all, four WE 177As were involved directly in the accident; the DA has no knowledge of the contents of the (fourth) other loaded TCHD, nor has it any relevance to this report.

The brief particulars of the four weapons are listed in Annex 1. All were packaged in containers which had been refurbished in the last two years, with tool boxes removed and modified aluminium saddles (ie post Brügger recommendations, 1984).

2. DA INPUT

The weapon accident team was mobilised as a result of [REDACTED] signals. More detail of this will be reported elsewhere, but it should be pointed out that our strength included both [REDACTED] and [REDACTED], who were part of the original HWE design team working on WE 177A with a detailed knowledge of the whole R&D/Trials programme. Furthermore, the AWRE Control Room Senior Officer was HWE, who is equally steeped in WE 177, having been the Senior Design Engineer on the 'B' and 'C' versions.

This aspect cannot be stressed too highly - any judgements that have been made on behalf of AWRE, are based on a wealth of experience and detailed knowledge.

What happened at the site is best understood by reference to Annex 2-4, the Flash Reports prepared by the DA representatives at the scene. It takes the situation up to 17.00 on Tuesday 13 when the weapons had been examined, repacked in new containers and declared safe for temporary storage within the Naval Armament Depot at Dean Hill.

3. DA VIEWPOINT

In making a judgement it should be recognised that:-

3.1 The weapons in the second vehicle were subjected to no severe shocks. There were no impacts, with the ride experienced being no more severe than would be encountered in normal transportation.

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The subsidence of the verge and subsequent winching of the vehicle would subject the weapon to environments significantly less than those specified in AWRE's Test Specification HTS/J/A69, Part V, dated August 1966, to which the weapon has been cleared and Approved as both safe and serviceable.

3.2 The weapons in the first vehicle experienced a more severe environment than those of the second vehicle; these are assessed in Annex 5. Even these low accelerations are over estimates, since this simple treatment does not take account of the attenuation afforded by the construction of the container and its tie downs.

Annex 6 summarises the requirements of the test specification covering the accelerations and temperatures against which hardware was qualified.

These accelerations exceed those seen at Brügggen, where the assessed accelerations (Annex 5) were four times those of this incident. This leads to the firm DA conclusion that the Dean Hill levels are trivial.

Over the years accident information is accruing to substantiate the DA's confidence in the robust nature of the design - a further example of this was in the evidence from the South Atlantic "Rough Handling Incident" - there was significant damage to the bomb casing, but none to the warhead internals as demonstrated by a detailed strip-down as part of the surveillance programme.

It must be stressed that this is a weapon designed to impact upon hard concrete runways, when dropped from high speed aircraft from low level. Admittedly it only has to be serviceable after such an environment, but the DA is stressing that the weapon is extremely robust and there is no reason to doubt its serviceability after the accelerations experienced in this accident.

What needs to be assessed is the safety - it is our view that in addition to being serviceable it is also safe. The evidence for this is:-

(a) Health Physics checks by means of Tritium monitor NIS 221 revealed no traces of gas either in the container voids or at the joints of the ballistic case.

(b) All safety checks carried out via the electrical monitor loops were satisfactory, namely:-

Safe to Enable Facility (SEF), which shows that no power had entered any of the weapon sub-systems.

The three separate safety breaks (Option, Environmental and Arming Switches).

The shutter of the valve of the gas transfer system.

Arming and parachute timers.

Fuze battery and Hydrostat Arming Switches.

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- (c) Pressure tests showed the sealed centre section still retaining positive pressure, compatible (when corrected for ambient temperature) with those last routinely recorded.
- (d) The examination of the vehicle when on its side showed the containers to be secure in all their fixings, although two out of a total of twenty-eight chains had a slight relaxation of tension.
- (e) Both weapons remained firmly in their transit cradles within the containers. RAE report evidence of some sideways movement, with a witness mark on the saddle of the rear container. This is consistent with that seen on the rough handling trials carried out post Bruggen. It causes RAE no concern and will be reported more fully by them.
- (f) Crushable material was inserted in the free space between both the weapon and its container and the container and vehicle sides to inhibit store displacement prior to righting, and to reduce any adverse loads during the recovery process. In the event, the crane driver's control was such that little or no loading was introduced.

4. CONCLUSIONS

4.1 The AWRE Design Authority's view is that all four WE 177As Serial Numbers as listed in Annex 1 are safe and serviceable in respect of those items for which AWRE is the responsible Authority.

This view is endorsed by Director, AWRE, taking into account further advice from the Chairman of the WSCG.

4.2 RAE as the Design Authority for all other components and subsystems of the weapon assess that "All four weapons are safe and serviceable with regard to the functions for which RAE is the DA".

RAE recommend that A5715 and A5630 be returned to service.

However, recognising that A5050 and A5017 are relatively close to their refurbishment date RAE believe it would be prudent to refurbish prior to Service return.

ANNEX 1

WE 177 DETAILS

SERIAL NO.	BUILD DATE	REFURBISHMENT DATE	LIFE LEFT MONTHS	CONTAINER NO.
A5050	Dec '70	March '87	2	38)
A5017	March '71	Dec '87	11	28)
A5715	April '71	May '88	16	50)
A5630	Sept '70	June '87	5	52)

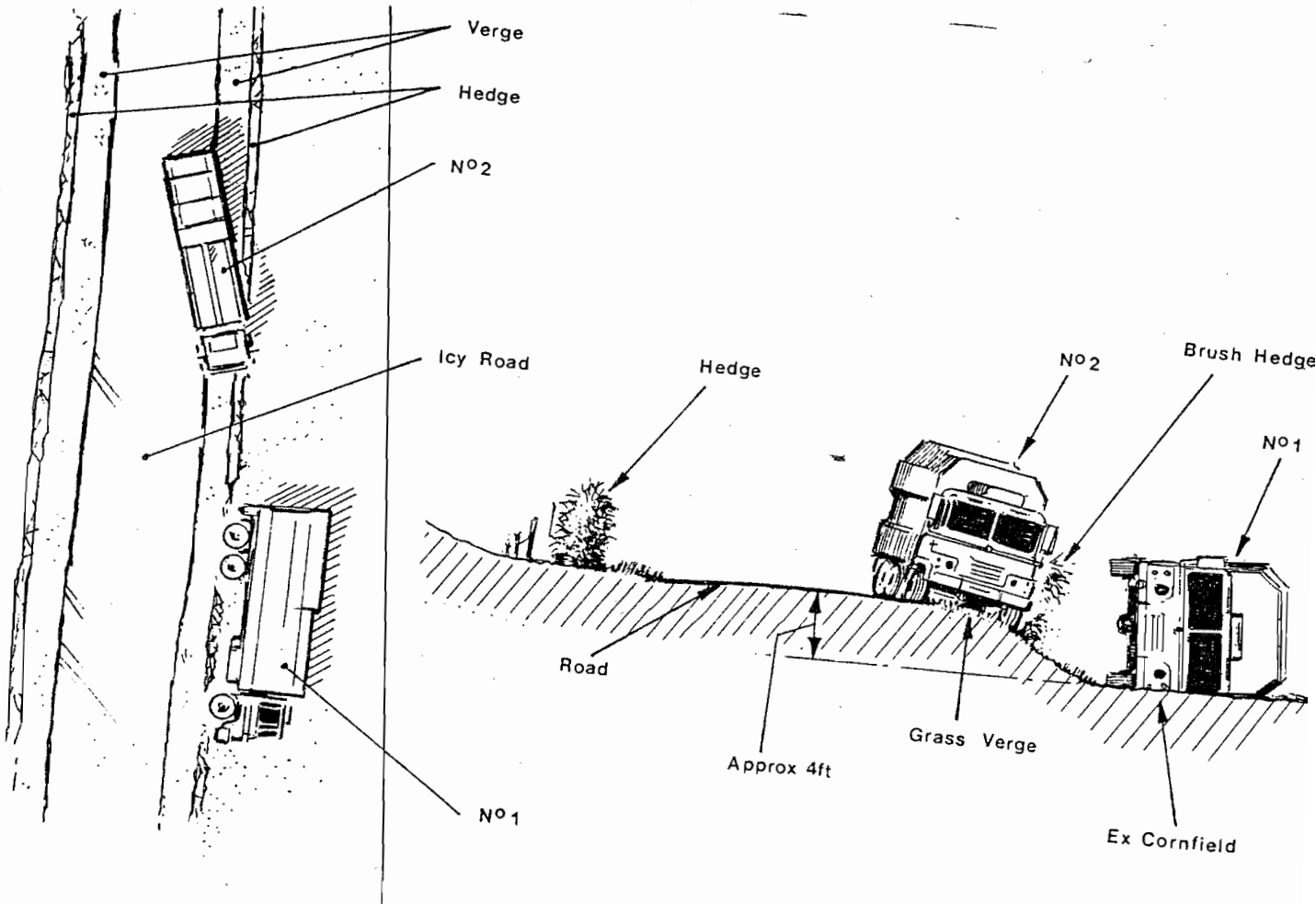
ANNEX 2

DETAILS AND SCENARIO

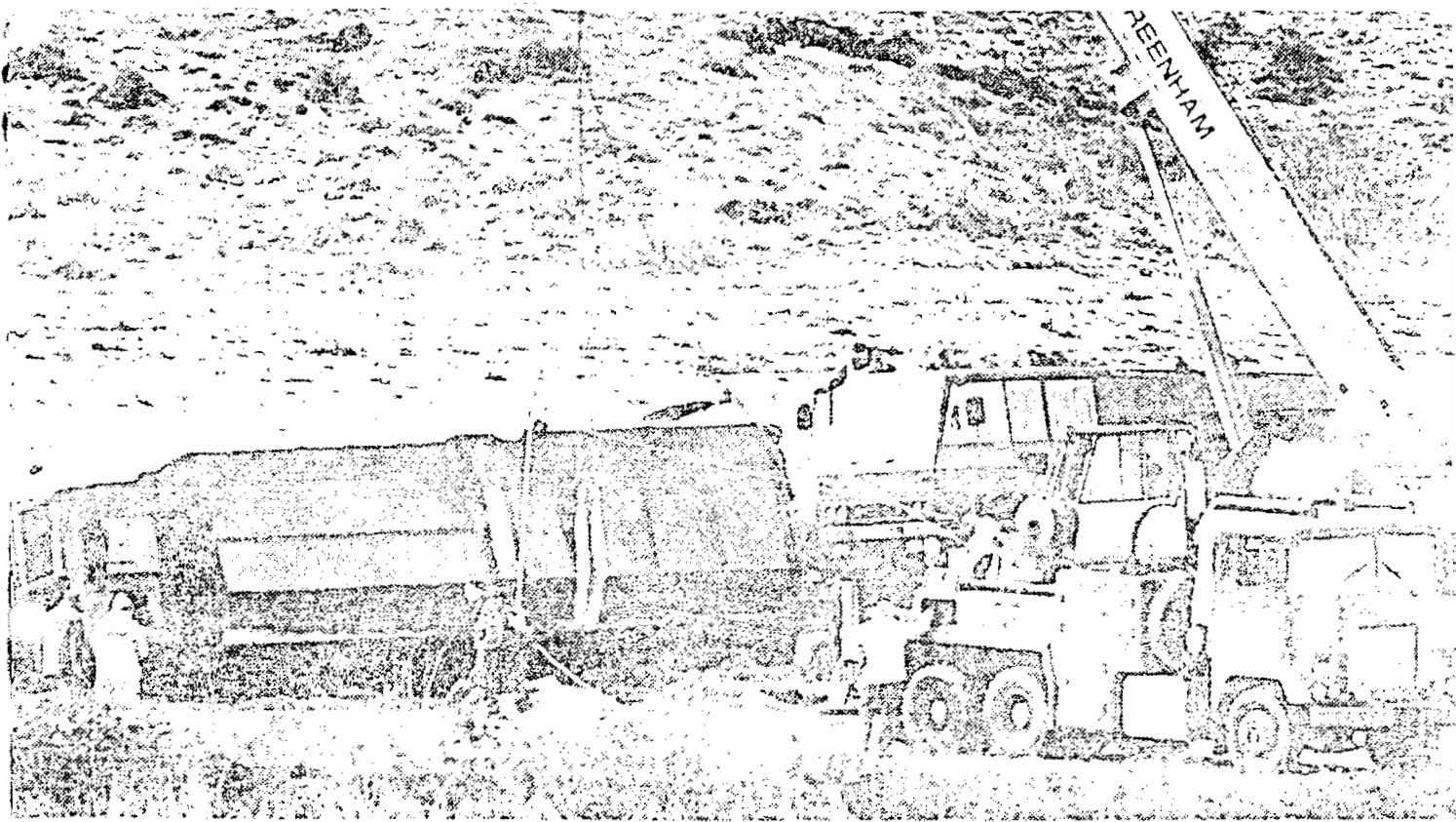
<u>LOAD CARRIER</u>	<u>CONTAINER</u>	<u>WEAPON</u>
1	38	5050
	28	5017 (Nearest Doors)
2	50	5715
	52	5630 (Nearest Doors)

All Weapons: WE 177 'A' 600 lb Stores.

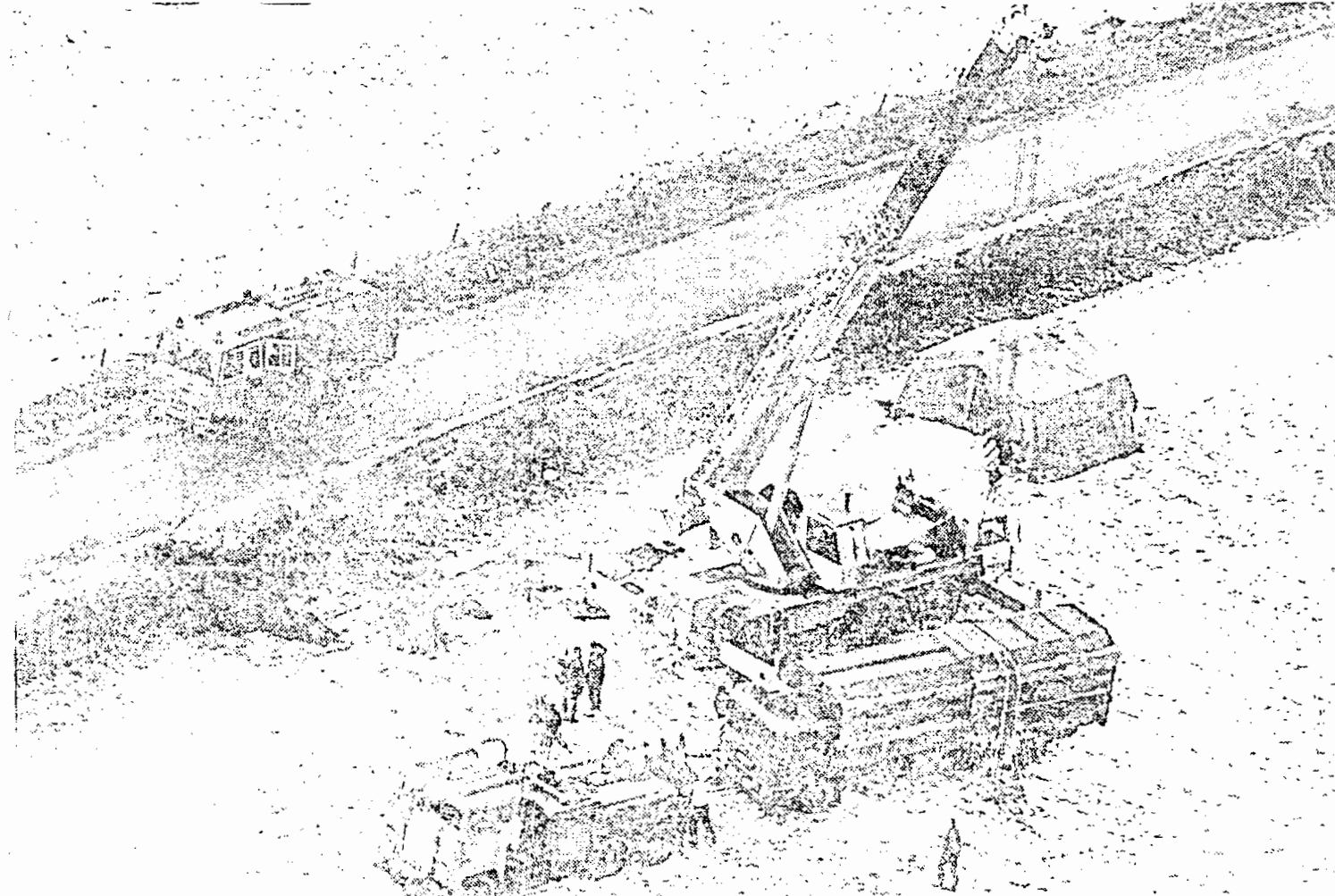
Load Carrier No. 1 on its near side in what had previously been a cornfield and was now stubble and frozen. Load Carrier No. 2 upright with its near side rear wheels on the grass verge and both its front wheels off the road and 'grounded' on its front axle area.



THE TIMES MONDAY JANUARY 12 1987



ue workers use a crane to lift the 20-ton transporter from the field where it lay after skidding off a country lane. (Photograph: Julian Herth)



al shot of the accident scene yesterday, after the weapons container, a Mammoth Major, had finally been righted. (Photograph: John Ma)

TEAM MUSTERED

Mr	[REDACTED]	SSS - Nominated Team Leader
Mr	[REDACTED]	SDE - Weapon Design
Mr	[REDACTED]	SPS - Health Physics
Mr	[REDACTED]	SPS - Health Physics
Mr	[REDACTED]	SXT - Explosives
Wg	[REDACTED]	S RAF REP AWRE Liaison

Mr [REDACTED] BEM. Driving the Mobile Laboratory.

Mr [REDACTED]. Driving the Land Rover pulling Generator Unit.

Mr [REDACTED] and Mr [REDACTED] present in Control Room.

Report given in LOG form

Saturday	10.1.87	17.45	Call out.
		18.10	Arrive at AWRE Incident Room F6.2. Two [REDACTED] signals received giving details.
		18.30	Loaded tools and equipment into Land Rover.
		19.40	Left AWRE. [REDACTED] driving Mobile Lab. [REDACTED] in Land Rover towing generator, Team in AWRE Dormobile.
		21.00	Arrive at Accident Site.
		21.15	Inspected Accident Site. Weather very cold, road a sheet of ice. Visibility good. Dry. To keep a low profile the site was not illuminated with lights.
		21.45	Opened back doors of No. 2 Carrier and inspected contents. All chain fixings secure. Discussed situation with Wg Cdr [REDACTED] the Incident Commander and suggested that No. 2 vehicle and contents could be winched backwards onto the road by the Scammell Wrecker Vehicle which had arrived.
		23.25	No. 2 load carrier winched onto the road and slowly moved off under its own power.
		23.59	Mr [REDACTED] and Mobile Laboratory had still not arrived (carrying sandwiches and hot coffee). Asked Civil Police to look out for him.

Sunday 11.1.87 01.00 Mobile Lab arrives and is parked near to the accident site. Released Dormobile to go back to AWRE. This vehicle had been used by the team up until this time as their operation centre (indeed the only place we could sit down and try and get warm).

02.40 The RAF erected a canvas tent over the back doors of No. 1 vehicle on its side and the bottom door was opened to gain access. (NB. the lead acid batteries had been removed soon after the accident).
NIS 221 Tritium Monitor test carried out - no reading.

The two containers were still rigidly chained to the carrier base. All the top 14 chains were tight but two of the bottom chains were slightly slack (out of 14 chains). Some loose tools and equipment **were** lying on the side, and these were removed from the vehicle.

The door of the rear container No. 28 (nearest the vehicle doors) was partially opened to about 60°, further opening being restricted by the vehicle. Container sniffed with the NIS 221 Tritium Monitor - no reading. The weapon was still held rigidly on its cradle and the saddle was still in position. Container closed up and proceeded to examine front container.

03.20 Opened door of Container 38 (nearest the cab). This door could only be opened about 45° because of vehicle obstruction. Container sniffed with the NIS 221 Tritium Monitor - no reading. Weapon still held rigidly on its cradle and saddle was still in position. Container closed up **and vehicle doors locked.**

04.00 Discussion with the Incident Commander and the following suggestions made to him before attempting to move or right the vehicle:

1. Pack the free space, as far as possible, between the weapon and the inside of the container with rubberised hair etc.
2. Pack the free space between the container and the vehicle walls with - car tyres, sleeping bags, mattresses, etc.

3. Asked for the diesel fuel in the tank to be removed (approx 35 gals). The IC said that the tank could not be drained or syphoned and the advice of the County Fire Officer was that it was safer in the tank.
- 04.30 Meeting between [REDACTED] self and crane drivers to discuss the plan of action for lifting and righting the vehicle. Their intention was to lift the vehicle with the 50T crane using two nylon straps at the back axle area, and to use the Scammell Wrecker winch to restrain it once it approached top dead centre. Safe working load of nylon straps 32,000 kg. It was made quite clear to them that if during the operation things were not going quite to plan, they should recover the situation and start again.
- 05.10 Started packing space between weapons and containers with rolled sleeping bags. Each container took 4 bags.
- 06.00 Started packing space between containers and vehicle with tyres, mattresses, sleeping bags
- 08.10 rolls felt etc. Completed at 08.10. During this time a trench was being dug by hand beneath the vehicle to pass the lifting straps around. (Very difficult as ground frozen).
- 09.15 Trench completed by 09.15.
- 09.30 Second AWRE team arrives.
- 10.00 Vehicle lifted and righted as per plan.
- 11.00 Vehicle winched onto road by the Scammell Wrecker and towed with towing bar in convoy to RNAD, Dean Hill.
- 11.50 Arrive at RNAD.
- 13.10 Depart RNAD.
- 14.10 Arrive AWRE. Team discussion with Dr [REDACTED].
- 15.00 Depart AWRE.

[REDACTED]
SDE

12 January 1987

ANNEX 3

Second Team Mustered on 11.1.87

Mr [REDACTED]	SLF	Team Leader
Mr [REDACTED]	SDE	Weapon Design
Mr [REDACTED]	SLR	Weapon Electronics
Mr [REDACTED]	SPS	Health Physics
Dr [REDACTED]	SXT	Weapon Explosives
Mr [REDACTED]	SWD	Communications
Cdr [REDACTED]		Sen Nav Rep, AWRE Liaison

Report given in LOG form

Sunday 11.1.87 0630 Call-out

0730 Arrive at AWRE Incident Room, F6.2

0815 Leave AWRE

0930 Arrive at RNAD

1310 Take over from first AWRE Team

1315 Team awaiting instructions to commence EOD operations

1830 Decision made not to proceed with EOD operations for time being. Leave RNAD.

2015 Arrive AWRE. Team discussion in Incident Room.

2045 Depart AWRE

No work was done by AWRE during this phase.

ANNEX 4

Team Mustered on 13.1.87

Mr [REDACTED] SLF Team Leader
Mr [REDACTED] SDE Weapon Design
Mr [REDACTED] SDE Weapon Design
Dr [REDACTED] SXT Weapon Explosives
Mr [REDACTED] SLR Weapon Electronics
Mr [REDACTED] SPS Health Physics
Mr [REDACTED] SWD Communications
Cdr [REDACTED] Sen Nav Rep, AWRE Liaison

Mr [REDACTED], BEM) Health Physics
Mr [REDACTED]) Mobile Lab

Report given in LOG form

Tuesday 13.1.87 0600 Team mustered in F6.2 Co-ordination Centre.
Departure delayed because the transport vehicle
would not start due to the very cold weather.

0625 Depart AWRE in Dormobile.

0745 Arrive at RNAD, Dean Hill, Wilts.

0750 Briefing meeting with Depot Supt, Mr [REDACTED] from
Gosport, who was standing in for Mr [REDACTED],
the permanent Depot Supt, who had been 'stood down'.

Present: AWRE Team
Cdr [REDACTED], RN, DGST(N)/CINO
W/Cdr [REDACTED], RAF
Mr [REDACTED]) RAE Farnborough
Mr [REDACTED]) Special Weapons

Plan of action discussed. Cdr [REDACTED] to be
in charge of the whole operation.

0930 Team move to the Mobile Lab situated near the TCHD
load carriers at Building 25 where the work is to
take place.

RAF Convoy personnel tow out No. 1 TCHD from the
hardstanding into Building 25.

1020 Containers 28 and 38 unloaded from vehicle and
vehicle removed.

1215 Door of container 28 opened and "sniffed" with Tritium monitor NIS 221 - no reading. The four packs of compressible packing were removed and the weapon (A5017) and cradle visually examined in situ.

Extension rails fitted to the container and the weapon withdrawn.

Weapon joint between the shells A1 and A2 "sniffed" with the NIS 221 - no reading.

Weapon, cradle and saddle visually inspected. Weapon pristine. There was a slight witness mark on the top starboard side edge of the saddle as if it had just 'kissed' the inside of the container. There was also a witness mark on the inside of the container corresponding to the saddle position, but no deformation.

1245 The RAE specialists checked the torques on the four tie rods. The torques had relaxed from their 55 lb/ft figure to approximately 40 lb/ft.

1300 The RAF Weapon Load Specialist then proceeded to carry out the safety checks working from Document CD 110B-0101-5. Using the Instrument Bomb Arm Test Set (IBA) they checked all the monitor loops from the test socket of the Ground Control Unit (GCU). All readings were in the 'Green Band' - Satisfactory.

1330 Pressure reading taken of the capsule pressure via the Schruder valve in the weapon:
Reading 7 psig at -7°C.
Previous reading from the weapon history documents' was 9 psig at 14°C on 7.1.87.
Making a correction for the temperature variation the corrected reading would be approximately 8.7 psig.
This is considered acceptable.

1400 Reported the results of the safety checks to AWRE Control.

The weapon (A5017) was then removed from the old cradle and secured onto a new cradle, which was then loaded into a new container.

1420 Container 38 door was opened and "sniffed" with the NIS 221 - no reading. The four packing pieces were removed and the weapon (A5050) and cradle visually examined.
Extension rails were fitted and the weapon withdrawn.

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- 1500 The weapon joint between shells A1 and A2 was "sniffed" with the NIS 221 - no reading. The weapon, cradle and saddle were visually inspected. Weapon pristine. There was a very slight witness mark on the top port side edge of the saddle. There was no corresponding mark on the inside of the container.
- 1515 The RAE specialist checked the torques on the tie bars. They had relaxed to approximately 40 lb/ft.
- 1530 The RAF weapon load specialists again carried out the safety checks.
All monitor loops in the Green Band reading.
Capsule pressure 6.5 psig at -7°C.
Previous reading from the history document was 8.75 psig at 13.5°C on 8.1.87.
Making a correction for temperature the corrected reading would be approximately 8.1 psig.
Considered acceptable.
- 1600 Reported the results of the safety checks to AWRE Control.
- The weapon A5050 was then removed from the old cradle and secured onto a new cradle which was then loaded into a new container.
- 1630 The accepting officer, Cdr [REDACTED] CINO, was then given an assurance by Mr [REDACTED] the Team Leader, that the weapons were safe for movement and storage in the magazines.
- 1700 AWRE team left RNAD Dean Hill.
- 1815 Arrive at AWRE and debrief.

[REDACTED]
for SDE
14.1.87

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ANNEX 5

A simple numeric assessment has been made of the acceleration seen by the weapon.

It assumes:-

1. No forward velocity (based on driver's description and road markings.)
2. That the vehicle was dropped vertically on its side from a height of 4 ft, with no energy losses due to vehicle distortion, earth movement etc.
3. That vehicle was brought to rest within 2 ins of its contact with the ground.

The DA consider the above scenario to represent a worst case model of the true incident. Based on this model the following calculations can be realised.

$$\text{From } V^2 = u^2 + 2gs \quad \text{where } s = 4 \text{ ft and } g = 32 \text{ ft/s}^2$$

$$V = 16 \text{ ft/sec} \quad \text{where } V \text{ represents the impact velocity}$$

During the following deceleration phase the maximum g loading can be calculated from,

$$a = \frac{V^2}{2s}$$

$$a = 24g$$

This assumes uniform constant acceleration.

A further means of establishing an estimate of the g loading experienced by the store is to consider the saddle, within the container, oscillating, with its displacement relative to the ground (ie including the vertical motion of the TCHD).

During the first quarter period of oscillation

$$\omega = \frac{2\pi}{T}$$

From work carried out after the Brügggen incident the period of oscillation due to side on loading was estimated as 80 ms (EPS report 1379).

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Therefore $\omega = 78.6$ rads/sec

and if we assume a maximum displacement as before of 2"

then the peak deceleration is $a^1 = \omega^2 x = 32g$

As can be seen the two routes give similar values; one being a constant acceleration, the other simple harmonic motion. However, the DA considers both are over-estimates by perhaps a factor of 2.

Finally, the DA estimates that the above estimate of 24g represents a worst-on-worst calculation and that the actual stores peak decelerations would have been much less than this. The DA concludes that the deceleration environment experienced by the store is trivial.

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ANNEX 6

SPECIFICATION and TESTING

1 The AWRE hardware in the WE177 series of weapons was developed to meet the weapon specification WE148. This specification was met to the satisfaction of the Warhead Approving Authority as interpreted by Document HTS/J/A69 Part V - "AWRE ENVIRONMENTAL TEST SPECIFICATION FOR WARHEADS".

2 This latter specification translates WE148 into a detailed ground testing requirement and includes all relevant environments.

3 All AWRE major trials included representative AWRE hardware, mounting structures, ballistic case and representative nose and tail sections where deemed necessary.

4 Acceleration

4.1 The highest accelerations occur in the laydown delivery modes; here the most damaging velocities and angles of impact were selected from a range of development test vehicles, and these form part of the 'impact' phase of the test schedule. Final approval vehicles were tested at:-

Impact Vel. (ft/sec)	Impact Angle	Temperature
130	30°) -20°C
112	80°) and) +45°C

Measured accelerations peaked in the order of 3000 g and supporting design calculations assumed an equivalent static 'g' of 500.

4.2 Acceleration tests enveloping parachute snatch conditions resulted in the following steady state acceleration requirement to be applied for one minute:-

Axial g	Transverse g
270	66

These 'g' values were applied using the AWRE centrifuge.

5 All tests were successfully completed and strip-down examination and test demonstrated the serviceability of the relevant AWRE hardware.

6 Trials to meet other shock conditions were carried out by RAE (Trials HE/TTR/77/342) and demonstrated that weapon tests on Naval pallets, mounts, trolleys etc. limited the shocks to less than the 66 g transverse value (see 4.2 above) to which all AWRE hardware was fully qualified.

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