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OPERATION GRAPPLE-Z

INTERIM REPORT

PART 17. WEAPON INSTRUMENTATION GROUP

PART 18. WEAPON MEASUREMENT GROUP

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Trials Planning Branch,
AWRE, Aldermaston,
Berks.

November, 1958.

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INTERIM REPORT

PART 17. WEAPON INSTRUMENTATION GROUP

PART 18. WEAPON MEASUREMENTS GROUP

1. Group Tasks

1.1 Group Responsibilities

[REDACTED] The telemeter was also used for test procedures during weapon assembly; hence the Group and its activities were located in the WA Area at Christmas Island.

WM Group was responsible mainly for receiving the telemetry transmissions and converting them into permanent records from which the desired information could be obtained. The Group was situated at C-Site in the forward area of Christmas Island.

Transmitters were fitted in balloon rounds by CC Group.

1.2 WI Group Tasks (Air Drops Only)

[REDACTED]

1.3 WM Group Tasks

[REDACTED]

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Tasks for Balloon Rounds

WM4 Telemetry recording of the state of the weapon firing circuit and [REDACTED] equipment and [REDACTED] where fitted, in various test periods and in the period up to firing as required by WF(B) Group. Provision of f.m. signals from both carrier frequencies for CC Group displays on the Control Desk.

WM5 Telemetry recording of the operating performance of the weapon firing circuit and [REDACTED] equipment at the instant of firing of balloon rounds. Provision of [REDACTED] pulse monitor display in S2 (C-Site) for WF(B) Group. Use of this equipment for calibration and testing as required by WF(B) Group during rehearsals and ground tests.

WM6 Measurement of implosion time as in Task 3 and also by the cut in telemetry carrier during the [REDACTED] pulse.

Tasks Common to Air Drop and Balloon Rounds

WM7 Recording the light flash and determining the time from first light to first minimum for rapid assessment of yield.

WM8 Operation of electronic control equipment associated with cameras of PS Group at C-Site, on behalf of CC Group.

WM9 Observation of maximum fireball diameter and duration to [REDACTED] by pinhole camera for rapid assessment of yield.

2. Group Composition

2.1 WI Group

[REDACTED] Group Leader
[REDACTED] Deputy Group Leader

2.2 WM Group

[REDACTED] Group Leader
[REDACTED] Deputy Group Leader

[REDACTED] (Photographer on loan from PS Group)
[REDACTED] " " "
[REDACTED]

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3. Brief Description of the Telemetry System

3.1 The F.M. Channel

Up to twelve slowly varying voltages, which represent the state of the firing circuit, are selected in turn by a rotary or electronic switch. The output histogram is used to frequency modulate a [REDACTED] sub-carrier which in turn modulates a [REDACTED] carrier. After reception and detection the histogram is displayed on the screen of an oscilloscope and used as a monitor at the Control Desk and elsewhere. The twelve channels assume levels characteristic of the state of the weapon at various times. The histograms used are shown in Figs. 5, 6, 7 and 8.

When recordings are required, the time base is switched off; the display then assumes the form of twelve bright spots on a faint vertical line. A recording film is moved continuously across the display, thus imparting a time scale to the resultant photographic record. Extracts from such records are shown in Fig. 2.

3.2 The Pulse Channel

High Speed information on the operation of the firing circuit is coded in the form of pulses which modulate the [REDACTED] carrier, simultaneously suppressing the f.m. sub-carrier for about a millisecond. These pulses are displayed on a variety of high speed oscilloscopes and photographed.

The names and functions of the pulses follow, in the order of their occurrence. Not all pulses are used in all weapons.

Code Pulse This is a [REDACTED] duration pulse generated in the telemeter when triggered by a voltage pulse occurring when the trigatrons are pulsed.

Current Zeros A short pulse is transmitted when each of the two trigatrons starts to conduct. The pulses are separated by a pre-calibrated delay.

End Events A short pulse is transmitted when the first detonator fires and a second one when the last detonator fires. A pre-calibrated delay-cable delays the second pulse by about [REDACTED] relative to the first one.

Staircase This is a stepped pulse waveform generated just after the end events and is used as an amplitude calibration of the [REDACTED] when [REDACTED] equipment is used.

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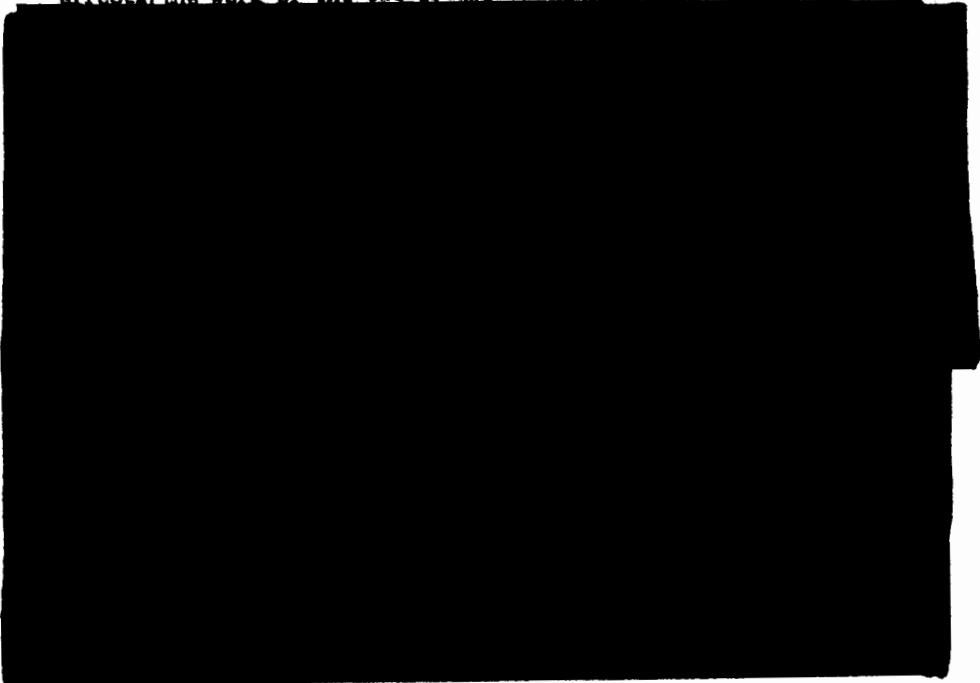
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4. Auto-Observer Results and Other Information

In the lists of results given for each round, such information such as dates, times, position of burst, aircraft number, etc. has been included for completeness or because it affects the work of the two Groups and should be recorded.



5. Use of Radio Flash to Determine Implosion Time

By use of a tuned aerial and  amplifier, a high frequency component of the radio flash is mixed with telemetry signals and follows identical circuit paths, finally appearing with the end events on a spiral timebase. The time from first end event to first radio flash can be read off directly to better than . The pulse shape given by this  component appears similar to a sharply differentiated version of the full radio-flash waveform, with all peaks turned  by the action of the IF strip detector. Hence a clear indication is given of short intervals at the start of the waveform. 



6. Results

Tables of results for the various practice and live rounds in the chronological order in which they were fired are given in appendices A1 - A15 at the end of this report.

It should be noted that telemetry results were obtained on many other balloon rehearsal trials, including tests prior to Operational Rehearsals and live firings. These have been omitted for brevity in this interim report.

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7.3 WI Group Equipment

The sharing of Mr. [REDACTED] efforts with WM Group resulted in some hold up in the preparation of the new telemetry building in the WA area. However, at the conclusion of the trial one station was operational and the other was mechanically complete.

7.4 WN Group Summary

All tasks were successfully completed with the exception of Task WM3 for [REDACTED]

[REDACTED]

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7.5 WM Group Difficulties

A major difficulty encountered was in measurement of short firing circuit time intervals, this being due to the poor pulse shapes obtained for current zeros and end events.

[REDACTED]

[REDACTED]

7.6 Quick Yield Estimates

The time to first minimum, and maximum fireball diameter measurements, the latter by pinhole camera observation, were obtained for all live rounds.

[REDACTED] Since HM Group are producing results just as quickly available, but accomplished over a greater variety of more precisely defined wavebands, it is recommended that WM Group cease expending effort on the measurement of light intensity.

It is also recommended that the pinhole camera be used as a simple and reliable means of visual observation but no serious attempt be made to use it as a measuring instrument.

7.6 WM Equipment

A considerable replacement programme has been requested for future trials in order to overcome some of the deficiencies mentioned above; to replace equipment which was provided for the original Grapple and is now excessively unreliable; and to harden the "one-off" designs which were improvised in the short time scale allowed for subsequent trials.

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OPERATION GRAPPLE-Z

INTERIM REPORT

PARTS 17 AND 18. WEAPON INSTRUMENTATION AND MEASUREMENT

APPENDIX A - TABLES OF RESULTS

A1 Results of Telemetry Measurements & Related Data for Balloon Rounds

A1.1 General Data:

Weapon: Pennant 1. H.E.
Date of Trial: 14/8/58.
Type of Trial: Ground Firing at HE Site approx. 700 yd
south of Ba.1.
Time of Firing: 19.15.
Cloud cover, approximate. Clear.

A1.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No: Link A No. 7; Link B No. 3.

1. Carrier frequency: 1. (Station S2G) Link A
2. Carrier frequency: 2. (Station S2W) Link B
3. Code pulse duration at 90% amplitude, frequency 1.
4. Code pulse duration at 90% amplitude, frequency 2.
5. Transmitter delay to current zeros
6. Transmitter delay to end events
7. Transmitter delay to [REDACTED] pulses
8. Sub-carrier frequency at earth level

Encoder T2024 Serial No: Link A No. 1; Link B No. 6.

9. End event separation calibration

[REDACTED] Unit 506 Serial No:

[REDACTED] Unit 523 Serial No: 3.

11. First current zero to [REDACTED]

(i.e. code pulse to [REDACTED])

13. Code pulse to Staircase on [REDACTED]
14. F.M. [REDACTED] calibration voltage
15. [REDACTED] duration at Fire on [REDACTED]
level with top step:

A1.3 Optical Measurements

NIL.

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A1.4 Measurements from Telemetry Transients

Firing Circuit

End event separation (probable, link B only)
End event separation during simulated pulses
End event scatter (doubtful accuracy)
First current zero to first end event,
corrected for delays:
* Code pulse to first current zero, uncorrected:
Code pulse duration at [REDACTED],
frequency 1.
Code pulse duration at [REDACTED],
frequency 2.
Carrier frequency 1.
Carrier frequency 2.
* Code pulse to C.Z. when fired on [REDACTED]

Carrier Persistence/Implosion time

First end event to telemetry carrier out-off,
frequency 1.
First end event to telemetry carrier out-off,
frequency 2.

Not obtained

Transients

First current zero to Staircase at fire:
First current zero to [REDACTED]
(Corrected for delays).
at [REDACTED]
(Corrected for delays).

Transient peculiarities:

1. The time from code pulse to current zero is extraordinarily long. A spurious trip of the code pulse generator is indicated.
2. It is thought that a very small first end event can be detected on one Tektronix record [REDACTED]. Accurate time measurements of this pulse are not possible.

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3. No [REDACTED] pulses were received from [REDACTED] at any time.
4. The staircase decreased in amplitude throughout the firing sequence until the second step was barely visible above the base line. Although [REDACTED] appeared to fall in amplitude as well, the two pulses did not decrease equally, giving a spuriously high value for [REDACTED] amplitude.
5. A large staircase shaped pulse of about [REDACTED] duration appeared [REDACTED] from the code pulse as the telemeter broke up. This caused some displays to trip again.

F.M. Records

[REDACTED] integrated outputs are given in the above table.
General comment and special remarks follow.

The records appear normal except as follows. Control switching steps at [REDACTED], [REDACTED], [REDACTED], [REDACTED], [REDACTED], [REDACTED], [REDACTED] and [REDACTED] cause cross talk on the line d.c. display, and at the same time put notches in the "Safe/Live" level. These notches also appear on the radio telemetered F.M. displays.

[REDACTED]
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A2 Results of Telemetry Measurements & Related Data for Balloon Rounds

A2.1 General Data:

Weapon: Pennant 2.
Date of Trial: 16/8/58.
Type of Trial: Balloon, Scientific Rehearsal.
Time of Firing:

A2.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No:

1. Carrier frequency: 1.
2. Carrier frequency: 2.
3. Code pulse duration at [REDACTED], frequency 1.
4. Code pulse duration at [REDACTED], frequency 2.
5. Transmitter delay to current zeros.
6. Transmitter delay to end events.
7. Transmitter delay to [REDACTED] pulses.
8. Sub-carrier frequency at earth level.

Nominal

"

"

"

Drifts [REDACTED] to stabilize at

Encoder T2024 on WF encoder Serial No:

9. End event separation calibration

Current zero delay cable Serial No:

10. Current zero separation calibration:

[REDACTED] Unit 506 Serial No:

[REDACTED] Unit 523 Serial No:

11. First current zero to [REDACTED]
(Code pulse to [REDACTED])

12. Staircase voltages 1.

2

3

4

volts

volts

volts

volts

13. Code pulse to Staircase on simulation

14. F.M. [REDACTED] calibration voltage

volts

15. [REDACTED]

A2.3 Optical Measurements

NIL.

A2.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation
Current zero scatter
End event separation during simulated pulses
Code pulse to first current zero
Code pulse duration at [REDACTED], frequency 1.
Code pulse duration at [REDACTED], frequency 2.

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~~TOP SECRET~~ [REDACTED]

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[REDACTED] transients

First current zero to Staircase at fire:

First current zero to [REDACTED]

Transient peculiarities:

1. Two [REDACTED] ceased to pulse during the trial.
2. End events on link B were quite inadequate in size.
3. At fire, current zeros were less than [REDACTED] of required size; it was fortunate that they were detected at all.
4. [REDACTED]

F.M. Records

[REDACTED] integrated outputs are given in the above table.

General comment and special remarks follow.

F.M. records normal.

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~~TOP SECRET~~ [REDACTED]

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A3. Results of Telemetry Measurements & Related Data for Balloon Rounds

A3.1 General Data:

Weapon: Pennant 2
Date of Trial: 18-19/5/58
Type of Trial: Operational Rehearsal
Time of Firing: 08.50
Cloud cover, approximate: Eight eighths.

A3.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No: Link A No. 2, link B No. 1.
1. Carrier frequency: 1. link A [REDACTED]
2. Carrier frequency: 2. link B [REDACTED]
3. Code pulse duration at [REDACTED], frequency 1. [REDACTED]
4. Code pulse duration at [REDACTED], frequency 2. [REDACTED]
5. Transmitter delay to current zeros [REDACTED]
6. Transmitter delay to end events [REDACTED]
7. Transmitter delay to [REDACTED] pulses [REDACTED]
8. Sub-carrier frequency at earth level [REDACTED]
WF encoder Serial No: 4 [REDACTED]
9. End event separation calibration [REDACTED]
Current zero delay cable Serial No: Link A No. 4: link B No. 3. [REDACTED]
10. Current zero separation calibration: link A [REDACTED], link B [REDACTED] See note overleaf
[REDACTED] Unit 506 Serial No: [REDACTED]
[REDACTED] Unit 523 Serial No: [REDACTED]
11. First current zero to [REDACTED] (i.e. code pulse to [REDACTED]) [REDACTED]
12. [REDACTED]
13. Code pulse to Staircase on simulation [REDACTED]
14. F.M. [REDACTED] calibration voltage [REDACTED]
15. [REDACTED]

A3.3 Optical measurements

Nil.

A3.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation, link [REDACTED] link B [REDACTED]
Current zero scatter [REDACTED] zero*See note overleaf
End event separation [REDACTED]
End event separation during simulated pulses [REDACTED]
End event scatter [REDACTED]
First current zero to first end event, corrected for delays: [REDACTED]
Code pulse to first end event, uncorrected: [REDACTED]
Code pulse duration at [REDACTED], frequency 1. [REDACTED]
Code pulse duration at [REDACTED], frequency 2 [REDACTED]
Second current zero to second vaporisation pulse: [REDACTED]

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[REDACTED]
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[REDACTED] transients

First current zero to Staircase at fire:
First current zero to [REDACTED]

[REDACTED] data: Typical examples of variations of [REDACTED] delay times are listed below. A delay correction of [REDACTED] should be applied to each.

F.M. Records

[REDACTED] integrated outputs are given in the above table.
General comment and special remarks follow.
F.M. records appear normal.

* Subsequent to the trial it was found that the current zeros were incorrectly cabled, so that on link A one current zero was transmitted undelayed and delayed, the other current zero on link B. Hence the figures [REDACTED] represent current zero delay cable calibrations under very realistic conditions. Current zero scatter was obtained by measuring time from first current zero to first end event on each link: [REDACTED]

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[REDACTED]
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A4. Results of Telemetry Measurements & Related Data for Balloon Rounds

A4.1 General Data:

Weapon: Pennant 2
Date of Trial: 22.8.58
Type of Trial: Balloon live Trial
Time of Firing: 0900
Cloud cover, approximate: Six-eighths

A4.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No: link A No. 2: link B No. 1
1. Carrier frequency: 1. (link A, S2G)
2. Carrier frequency: 2. (link B, S2W)
3. Code pulse duration at [REDACTED], frequency 1.
4. Code pulse duration at [REDACTED], frequency 2.
5. Transmitter delay to current zeros
6. Transmitter delay to end events
7. Transmitter delay to [REDACTED] pulses
8. Sub-carrier frequency at earth level
WF encoder Serial No: 4
9. End event separation calibration
Current zero delay cable Serial No: link A No. 4;
link B No. 3.
10. Current zero separation calibration: link A
link B
11. First current zero [REDACTED]
(i.e. code pulse to [REDACTED])
12. Staircase voltages 1.
2
3
4
13. Code pulse to Staircase on simulation
14. F.M. [REDACTED] calibration voltage
15. [REDACTED]
Predicted time from first end event to first gamma

A4.3 Optical Measurements

Maximum fireball diameter (pinhole camera)
Time from first light to first minimum, red filter:

A4.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation link A [REDACTED] link B
Current zero scatter
End event separation
End event separation during simulated pulses
End event scatter
First current zero to first end event, corrected for
delays:
Code pulse to first end event, corrected:
Code pulse duration at [REDACTED], frequency 1
Code pulse duration at [REDACTED], frequency 2
Carrier frequency 1.
Carrier frequency 2.
First current zero to its vaporisation pulse:
Second " " " " " " " "

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Carrier Persistence/Implosion time

First end event to start of radio flash.

transients

First current zero to Staircase at fire:

First current zero to [REDACTED] at amplitude level with
2nd step

[REDACTED] width, from cut off to amplitude level with
2nd step

At fire, [REDACTED] amplitude exceeded amplifier linearity due to a fault on
the [REDACTED] relay.

FM Records

[REDACTED] integrated outputs are given in the above table.
General comment and special remarks follow.

The records are normal apart from the failure of channel 9 [REDACTED]
[REDACTED] Relay) to rise at [REDACTED]

Telemetry Notes

A radio flash signal was superimposed on all telemetry records.
This somewhat obscured any carrier cut-off points, but enabled im-
plosion time to be determined accurately.

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A13. Results of Telemetry Measurements and Related Data for Balloon Rounds

A13.1 General Data

Weapon Burgee
Date of Trial 18/9/58
Type of Trial Full Detonator Firing, (P.T.12) at height
Time of Firing 14.00
Cloud Cover, approx two eighths

A13.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No.

1. Carrier frequency: 1
2. Carrier frequency: 2
3. Code pulse duration at [REDACTED], frequency 1
4. Code pulse duration at [REDACTED], frequency 2
5. Transmitter delay to current zeros
6. Transmitter delay to end events
7. Transmitter delay to [REDACTED] pulses
8. Sub-carrier frequency at earth level
9. End event separation calibration

WF encoder serial No. 3

Current zero delay cable serial No. Link A No 1

Link B No 2

Current zero separation calibration:

Link A

Link B

11. First current zero to [REDACTED]
Code pulse to [REDACTED]
13. Code pulse to Staircase on simulation
14. P.M. [REDACTED] calibration voltage
15. [REDACTED]

Predicted time from first end event to first gamma

A13.3 Optical Measurements

Nil.

A13.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation: Link A [REDACTED] Link B [REDACTED]
Current zero scatter [REDACTED]
End event separation: Link A [REDACTED] Link B [REDACTED]
End event separation during simulated pulses [REDACTED]
End event scatter [REDACTED]
First current zero to first end event, corrected
for delays: Link A [REDACTED] Link B [REDACTED]
Code pulse duration at [REDACTED]; frequency 1 Link A [REDACTED]
[REDACTED] frequency 2 Link B [REDACTED]
Carrier frequency 2 [REDACTED]
Code pulse to first current zero: Link A [REDACTED] Link B [REDACTED]
2nd current zero edge to 2nd vapourisation pulse peak: [REDACTED]
Link A [REDACTED]
Link B [REDACTED]

Comments

The general shapes and amplitudes of transient pulses from the firing circuit cannot be regarded as ideal for accurate measurement.

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Transients

First current zero to Staircase at Fire

Staircase behaved normally throughout the trial.

Sequence	A	B	C	D	All	Comments
FIRE						From 1st C.Z.
Last						
Last but one						
Last but two						
Third						*Normal pulse width
Second						
First						
Visual report at						
Visual report at						

The above figures are for delays from trip to [REDACTED]
they are corrected for telemetry delay of [REDACTED]

F.M. Records

[REDACTED] integrated [REDACTED] were approximately equal to the calibration level, but were [REDACTED] down for [REDACTED]

F.M. was normal at [REDACTED] relay operated correctly.

F.M. was normal at Fire, detector volts did not recover.

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A14. Results of Telemetry Measurements and
Related Data for Balloon Rounds

A14.1 General Data

Weapon Burgee
Date of Trial 20/9/58
Type of Trial Operational Rehearsal
Time of Firing 09.00
Cloud cover, approximate one eighth

A14.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No: Link A No. 6 Link B No. 15
1. Carrier frequency 1. (Link A)
2. Carrier frequency 2. (Link B)
3. Code pulse duration at [REDACTED]
frequency 1
4. Code pulse duration at [REDACTED]
frequency 2
5. Transmitter delay to current zeros
6. Transmitter delay to end events
7. Transmitter delay to [REDACTED] pulses
8. Sub-carrier frequency at earth level
WF encoder Serial No. 3.
9. End event separation calibration
Current zero delay cable Serial No. Link A No. 1
Link B No. 2
10. Current zero separation calibration,
Both links
11. First current zero to [REDACTED]
Code pulse to [REDACTED]
12. Code pulse to Staircase on simulation
13. F.M. [REDACTED] calibration voltage
14. [REDACTED]
Predicted time from first end event to first gamma [REDACTED]

A14.3 Optical Measurements

Nil.

A14.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation: Link A [REDACTED] Link B [REDACTED]
Current zero scatter [REDACTED]
Code pulse duration at [REDACTED], frequency 1
Code pulse duration at [REDACTED], frequency 2
Carrier frequency 1
Carrier frequency 2
Code pulse to 1st current zero [REDACTED]

[REDACTED] transients

First current zero to Staircase at fire [REDACTED]
First current zero to [REDACTED]

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F.M. Records

[REDACTED] integrated outputs are given in the above table.
General comment and special remarks follow.

Records normal up to [REDACTED]. At [REDACTED] and [REDACTED] no
[REDACTED] actions occurred. All indications [REDACTED]
normal at "fire".
[REDACTED]

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A15. Results of Telemetry Measurements & Related Data for Balloon Rounds

A15.1 General Data

Weapon Burgee
Date of Trial 23.9.58
Type of Trial Live Trial
Time of Firing 08.59.59.9
Cloud cover, approximate four eighths

A15.2 Advance Telemetry Calibration Data

Transmitter T2023 Serial No: link A No. 6: link B No. 15

1. Carrier frequency: 1. link A
2. Carrier frequency: 2. link B
3. Code pulse duration at [REDACTED], frequency 1
4. Code pulse duration at [REDACTED], frequency 2
5. Transmitter delay to current zeros
6. Transmitter delay to end events
7. Transmitter delay to [REDACTED] pulses
8. Sub-carrier frequency at earth level

WP encoder Serial No. 3

9. End event separation calibration

Current zero delay cable Serial No. link A No. 1, link B No. 2

10. Current zero separation calibration: Both links
11. First current zero to [REDACTED]
Code pulse to [REDACTED]
12. Staircase voltages 1.
2.
3.
13. Code pulse to Staircase on simulation
14. F.M. [REDACTED] calibration voltage
15. [REDACTED]

Predicted time from first end event to first gamma
" " " first current zero to first end event
" " " code pulse to first current zero

A15.3 Optical measurements

Maximum fireball diameter (pinhole camera)
Time from first light to first minimum, red filter

A15.4 Measurements from Telemetry Transients

Firing Circuit

Current zero separation link A [REDACTED] link B
Current zero scatter
End event separation
End event separation during simulated pulses
End event scatter
First current zero to first end event, corrected
for delays:
Code pulse to first current zero, uncorrected
Code pulse duration at [REDACTED], frequency 1
Code pulse duration at [REDACTED], frequency 2
Carrier frequency 1
Carrier frequency 2
Start of 2nd current zero to peak of 2nd vaporisation
pulse

~~TOP SECRET~~

~~TOP SECRET~~ [REDACTED]

163

[REDACTED]
GZ/17/W1
GZ/18/WM

Carrier persistence/Implosion time

First end event to start of radio flash [REDACTED]

[REDACTED] transients

First current zero to Staircase at fire:

First current zero [REDACTED] at amplitude [REDACTED]

[REDACTED] widths at [REDACTED] amplitude and delays to mid-point, corrected.

Throughout the control sequence, three short [REDACTED], of [REDACTED]
[REDACTED] duration, were generated by [REDACTED]

F.M. Records

Normal everywhere except at [REDACTED] when the [REDACTED]
[REDACTED] indicating a transducer failure which caused
an electrical open circuit. Subsequently pips appeared on this level
at approx. [REDACTED] intervals, which were probably caused by cross-talk
between the two telemetry detection circuits being generated in the high
impedance open circuit.

Faults

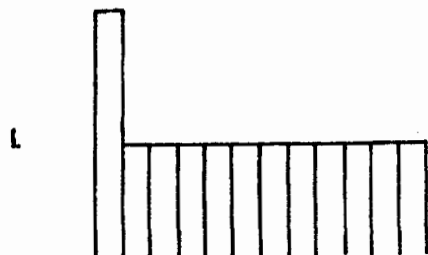
A number of setting up errors in the telemetry ground equipment
combined to produce violent spurious tripping when the carrier ceased
at fire. This caused a number of records to be obliterated, but the
overall information loss was negligible.

~~TOP SECRET~~ [REDACTED]

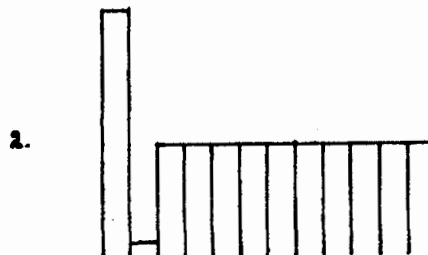
GRAPPLE - 2

P.M. Display Sequence for Blue Stone Balloon Bounds.

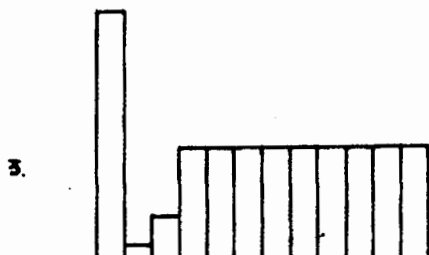
SAFE: Simulated code pulses only.



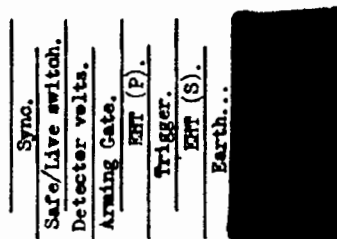
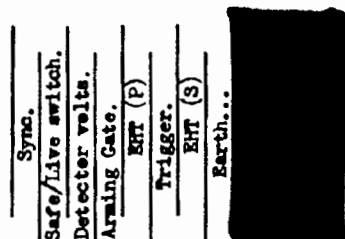
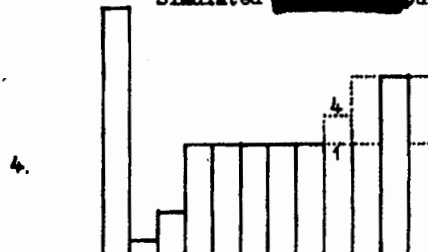
LIVE: Simulated code pulses only.



LIVE: Simulated code pulses & end events.

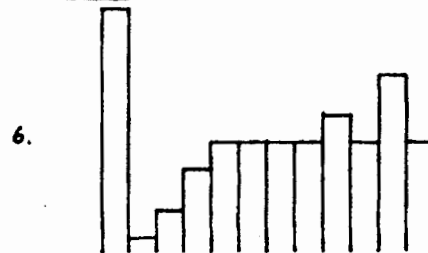
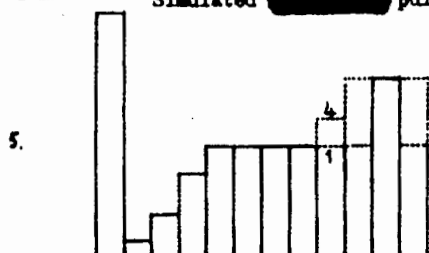


LIVE: Simulated code pulses & end events.
Simulated [redacted] pulses.



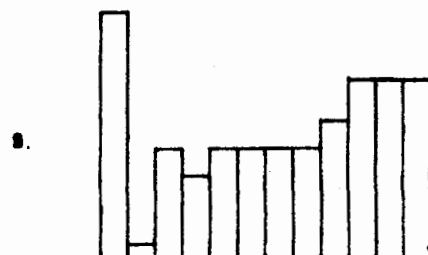
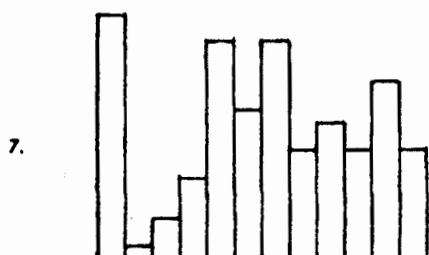
[redacted]: Simulated code pulses & end events.
Simulated [redacted] pulses.

[redacted]: All pulse simulation stopped.



ARM: All pulse simulation stopped.

INSTANT of FIRE: (Dummy lead).



GZ/17/WI
GZ/18/WI
170



GRAPHIC - 2. F.H. Display Sequence for Burger - [REDACTED] - [REDACTED] 0:11 - 0:14