EXPLORANIUM

GR-526C CHARGE-BUCKET Radiation Monitor

Software Version - 8V47

USERS MANUAL - Rev 4

Table of Contents

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USERS ARE HEREBY NOTIFIED THAT THIS MANUAL CONTAINS TECHNICAL INFORMATION OF A PROPRIETARY NATURE. THIS INFORMATION IS NECESSARY FOR TECHNICALLY KNOWLEDGEABLE USERS TO UNDERSTAND SYSTEM OPERATION AND TO SATISFY THEMSELVES THAT THE SYSTEM IS PERFORMING CORRECTLY.

EXPLORANIUM ACCEPTS THAT IT IS THE RIGHT OF SUCH USERS TO BE PRIVY TO THIS INFORMATION. HOWEVER THIS DOCUMENTATION IS PROVIDED SOLELY FOR THE BENEFIT OF OWNERS OF THE GR-526C SYSTEM AND DISSEMINATION OF THE DETAILED TECHNICAL INFORMATION PROVIDED MAY BE CONSIDERED AS LEGALLY CONTRAVENING THE NORMAL SUPPLIER/CUSTOMER RELATIONSHIP.

UNAUTHORIZED RELEASE OF DETAILED TECHNICAL INFORMATION TO A THIRD PARTY WILL BE CONSIDERED AS A CONTRAVENTION OF USER AGREEMENTS.

QUICK-START REFERENCE

This manual comprises various sections - for ease of use please note the following.

The user must determine which basic operational MODE the system is configured in, there are 3 different modes

a) MONITOR-WHILE-LOADING

b) MONITOR-WHILE-FULL

c) MONITOR-WHILE-LOADING - special

This system - Ser. # _____ is configured as _____

Refer to the following sections for specific information.

Note that most Alarm information, Parameter settings etc. are common to all modes so in these sections the common features are shown and any **DIFFERENCES** for a specific operational mode is noted at the relevant point.

Sections 1, 2 and 3 give background information on system applications.

d) MONITOR-WHILE-LOADING
- Operation - normal functions - Section 4
- Alarms - Section 7
- Detailed operation - Section 8
- System Parameters - Section 9

b) MONITOR-WHILE-FULL
- Operation - normal functions - Section 5
- Alarms - Section 7
- Detailed operation - Section 8
- System Parameters - Section 9

c) MONITOR-WHILE-LOADING - special
- Operation - normal functions - Section 6

- Alarms - Section 7
- Detailed operation - Section 8
- System Parameters - Section 9

1.0 RADIATION MONITORING - GENERAL

1.1 INTRODUCTION

The GR-526 Vehicle Radiation Monitoring system is the **state-of-the-art** radiation monitoring system for Truck/Rail vehicles in the scrap metal processing and recycling industries. The GR-526 has been specifically designed to detect the presence of dangerous shielded radioactive sources that are buried in loads of scrap metal.

In the past ten years there have been a number of incidents at metal processing plants, where radioactive sources hidden in incoming scrap, have been melted in electric arc furnaces. Most of these accidents resulted in significant radioactive contamination, with clean-up costs ranging up to $15 million. In some of the mills, where these accidents occurred, simple radiation detectors were installed at the time. These systems are able to detect some sources of radioactivity if they are not too deeply buried in a load of scrap metal, unfortunately they are not sensitive enough to detect buried shielded sources.

Large radioactive sources (the ones that cause serious contamination when melted in an electric arc furnace) are required by law to be installed inside a special safety shield. This ensures that the levels of radioactivity on the outside of the shield are low enough for safe handling. When such a shielded source is buried inside a load of scrap metal, the shielding effect is greatly increased. On the outside of a vehicle the amount of radioactivity coming from a shielded source buried in the scrap load is only a small fraction of the normal background radiation. Such small increases in radiation levels are extremely difficult to detect and as a result simple radiation level monitors, using small detectors, cannot provide effective protection against steel mill contamination.

To prevent these expensive, and potentially dangerous accidents, EXPLORANIUM developed the GR-520 Radiation Detection System in 1988, which was the first system capable of detecting BURIED shielded sources. This system was improved with the introduction of the GR-525 and now, the **state-of-the-art** GR-526. Exploranium has installed over 500 radiation detection systems in steel mills and scrap handling facilities in 17 countries including USA, Canada, Mexico, Germany, Sweden, Finland, Denmark, UK, Ireland and many countries in Asia.

As a “second-line-of-defence” many users have installed CHARGE BUCKET monitoring systems. Unlike a vehicle monitoring system where usually the trucks are of similar size and the operating logistics fairly common between steel plants -

Charge Bucket installations are often very different between plants due to significantly variable plant logistics.

For this reason the GR-526 has a special version labelled **GR-526C** that is specially designed for Charge Bucket applications. These systems were developed to meet the needs of the Metals processing industry and the systems include many special features that permit them to be adjusted to MEET THE SPECIAL NEEDS OF EACH SPECIAL LOGISTICS REQUIREMENTS without losing system performance.

There are various ways to assess system performance :

SYSTEM SENSITIVITY - a measure of the basic systems capability to detect a signal from a buried source and is primarily dependent on GOOD DETECTORS, GOOD ELECTRONICS and GOOD GEOMETRY (mounting the detectors reasonably close to the buckets) etc.

SOURCE DETECTABILITY - the SYSTEM'S ability to identify a source and starts with Sensitivity but is seriously affected by Bucket Size, Shape, In/Out logistics, Scrap loading methods, Crane operators cooperation, Vulnerability of installed location, Quality of Maintenance, Plant Logistics, Plant Operations and Plant Procedures in the event of an Alarm.

THE TERM DETECTABILITY IS USUALLY USED TO DENOTE THIS RESULTANT MEASURE OF SYSTEM PERFORMANCE.

However in the real world of a Scrap Handling facility, many of these factors are uncontrollable, and in the end these factors act as the main limit to system performance.

Many of these problems have been minimised in the GR-526C by the use of very sophisticated analysis methods, however some USER cooperation is essential to optimum system DETECTABILITY.

It is impossible for ANY system to catch ALL potential incoming sources for a variety of technical reasons. However the technology built into the GR-526C with our previous experience PLUS some recent major technical breakthroughs, make the GR-526C THE technical limit in this specialised monitoring technology. The GR-526C will detect almost all potential "normal" sources that can be expected to be in the scrap stream and compensate for most logistic limitations commonly seen in scrap handling facilities.

The GR-526C offers the highest level of sensitivity, ease of use and system reliability of any scrap metal radiation monitor, through the following features:

- Very large Polyvinyl toluene (PVT) “plastic” detectors.
- Individual bucket radiation analysis using advanced statistical analysis algorithms.
- Easy user interface via the large Graphics display plus printer output.
- One-button Alarm response for the user
- Continuous automatic system self-diagnosis with user notification
- Redundancy of key system components.
- Remote service support via built-in modem.
- Extensive Exploranium Service Centre support.
- FREE software updates for the life of the product to continuously improve performance

1.2 GR-526C SYSTEM DESCRIPTION (General)

The GR-526C Radiation Detection System normally consists of two major components: a system console and detector boxes (typically 2). The detectors are usually specially mounted to suit the applications (discuss with Exploranium). The system console is usually mounted the control room (pulpit) to provide immediate alarm information to operating personnel.

Radioactive sources, both naturally occurring and man-made, emit Gamma-rays that are absorbed by the detectors and produce scintillations, or small flashes of light, which are converted to pulses in the detector electronics.

The system console collects and monitors the Gamma-ray information from the detectors and displays the data on the front panel Liquid Crystal Display (Console Display) in a "chart recorder" format. If the system determines that a source of radioactivity is present, an audio alarm is sounded and detailed alarm information is displayed on the Console Display.

The console also performs continuous system diagnosis. If a component failure is detected, signals are re-routed to take advantage of redundant systems designed into the GR-526C. Any system faults that are detected, are displayed on the Console Display so that maintenance can be scheduled. The GR-526C will continue to operate even if some major components have failed, to give the user the MAXIMUM detection capability during this period.

1.3 MANUALS

There are various support documents available for the GR-526C system :

d. **SYSTEM SUMMARY SHEET** - 1 page laminated reference sheet

e. **USERS MANUAL** - complete system operation - Version 8V47 - Rev 4

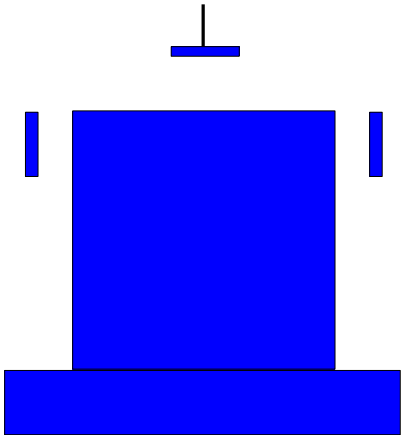
f. **MAINTENANCE MANUAL** - detailed support for Maintenance - Version 1.3

2.0 CHARGE BUCKET MONITORING SYSTEMS

The GR-526C - Version 8V47 supports many different types of Charge-Bucket monitoring as detailed below.

2.1 MODE 0 = MONITOR-WHILE-LOADING

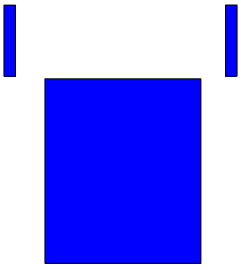
This is the most common method of charge-bucket monitoring as it has the highest probability of detection (DETECTABILITY). In this application 2 detectors are mounted on opposite sides of the bucket positioned close to the top lip of the bucket. See Fig 1.



This system can detect buried sources primarily in 2 ways :

a) On the magnet BEFORE the load is dropped
b) In the bucket AFTER the load has dropped.

SEE SECTION : 4



2.2 MODE 1 = MONITOR-WHILE-FULL - 1 BUCKET

In this application the bucket is monitored AFTER it has been loaded (i.e. when Full). This is a non-optimum method as if the bucket size is too large then there will probably be some small “dead-zone” area near the centre of the bucket where a SMALL buried source could be undetectable. However the reality of steel plant logistics sometimes force this application as the only possibility.

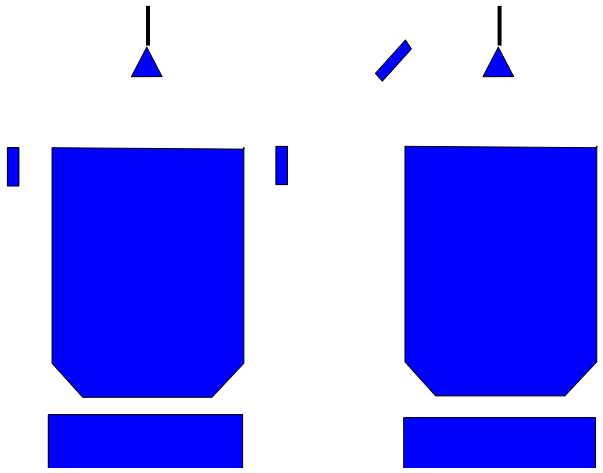
SEE SECTION : 5

2.3 MODE 2-6 = MONITOR-WHILE-FULL - MULTIPLE BUCKETS

Similar application to 2.4 above but in this case since multiple buckets are used - operator interaction is required to select the appropriate bucket size.

SEE SECTION : 5

2.4 MODE 7 = MONITOR-WHILE-FULL - C Detector TOP-UP



In this special mode, the A and B detectors operate in the Mode=0 mode as MONITOR-WHILE-LOADING detectors checking the scrap as the bucket is loaded. The “C” Detector operates independently and is not reliant on any optical sensor action. This mode is used by some users who check the bucket while loading then move it to a “top-up” scale where MORE scrap is added. The C detector located near this bucket position checks that no sources are present in the added scrap

SEE SECTION : 6

3.0 GENERAL CONSOLE DETAILS

The GR-526C Console has a front panel that provides the user interface to the system. In addition, there are two access doors on the lower third of the console. Behind the left access door is the printer used to obtain hard copies of alarms and warning messages. The right door conceals the terminal strip used to connect the detectors to the console and provides access to the power switch.

3.1 PRIMARY FEATURES

Primary features are:

Bright graphics Console Display for the display of messages, alarms etc.

RED button marked **ALARM** - push-button for use during a Radiation alarm

YELLOW button marked **STATUS** - push-button used for other user functions

Internal AUDIO buzzer referred to as **AUDIO BUZZER**

CLEAR, ENTER, RUN, STOP - special function keys used in Maintenance and System Set-Up - and a 10 key numeric keyboard - **0 - 9**

2 **ARROW** keys - for parameter selection when required

Internal **PRINTER** for hard copy of alarms (external Printer support if required)

Internal **MODEM** for Remote Maintenance access by telephone line

Special output for control of external **TRAFFIC LIGHTS**

Special data output (**RS-232**) permitting external data processing

Note that the system can be operated by **ANY** user by using **ONLY THE RED BUTTON,** as the other buttons are primarily for special features.

3.2 DIFFERENT MODES of system operation

This manual covers different modes of operation, user should refer to the Section that covers their installation

g. **SECTION B** - Monitor-while-Loading
h. **SECTION C** - Monitor-while-Full
i. **SECTION D** - Special Monitor-while-Loading

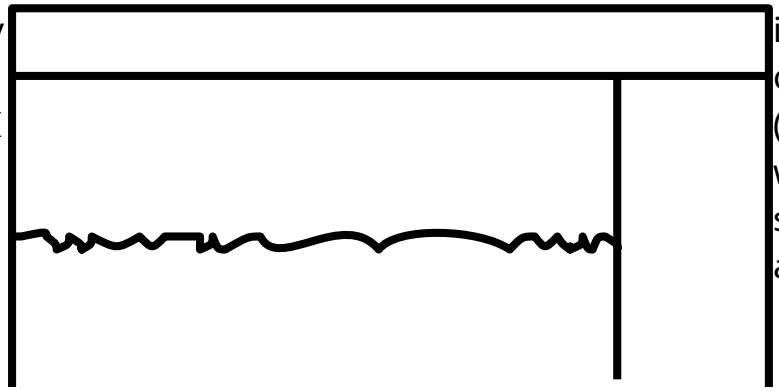
4.0 MONITOR-WHILE-LOADING - (Mode =0)

4.1 SYSTEM OPERATION - QUICK START

The following assumes that the GR-526C has been connected correctly, Exploranium Service Department personnel have supervised Start-Up and set all operating parameters correctly.

4.2 NORMAL DISPLAY (NO BUCKET IN PLACE)

The normal (BUCKET OUT) console display is shown in Fig. 4. During normal operation the screen is **DARK** (pressing any key switches it on), when a bucket enters the system detectors the screen automatically "lights up".



The message at the top of the display should say **SYSTEM READY** showing that the system is ready for monitoring if a bucket is entered.

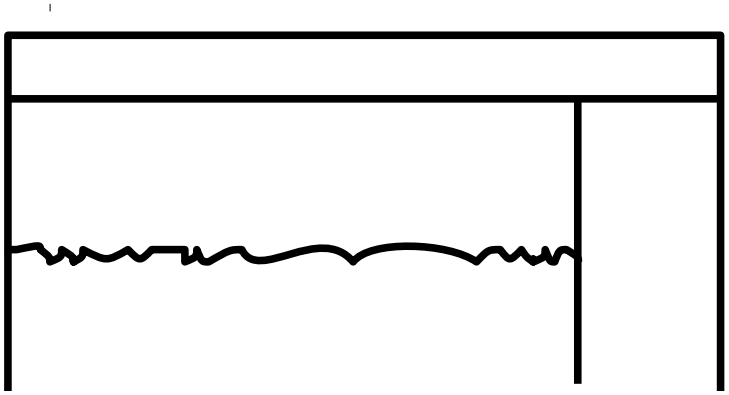
4.3 SYSTEM ERRORS

If the system detects a serious INTERNAL problem it advises the user with an audio "quick-beep" (3/sec rate). The user should press the **STATUS** front panel BUTTON to acknowledge this warning and advise Maintenance of the **WARNING MESSAGE**

display on the Console Display in the location indicated on Fig. 4.
.

4.4 NORMAL DISPLAY - when a BUCKET is being MONITORED

During BUCKET-IN monitoring - the STATUS message shown on Fig. 5 indicates the current status of system operation.



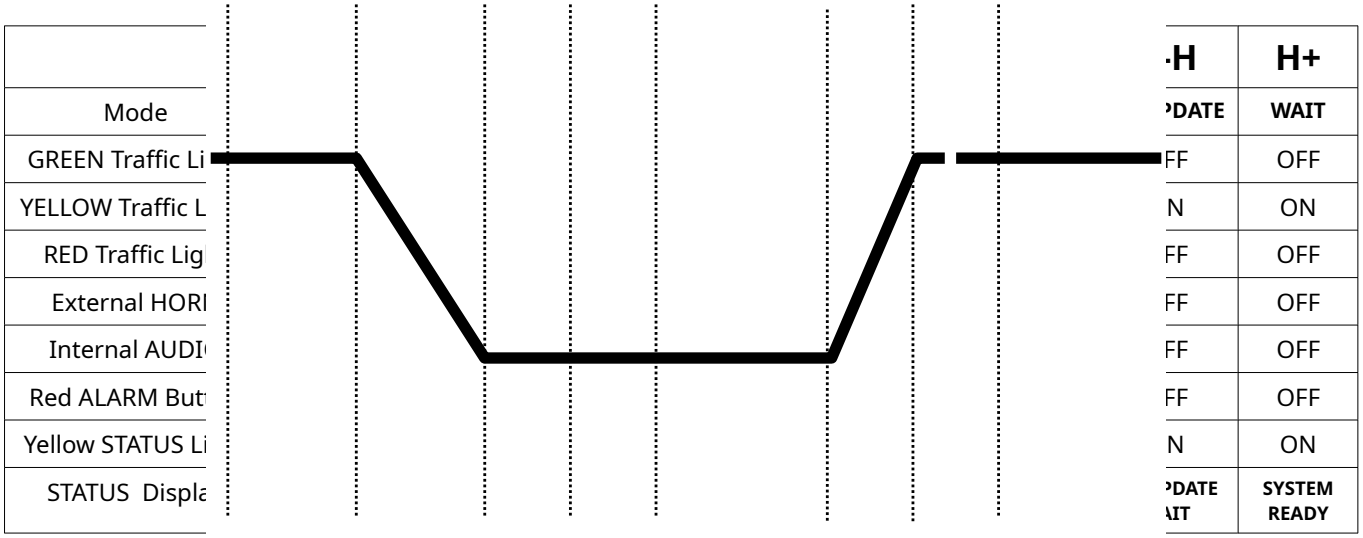
Messages may be :

- **BUCKET > IN** - showing that 1 of the OS units has been activated and the Bucket is moving IN.
- **BUCKET IN** - showing that the Bucket is now correctly in place and system parameters are being analysed - NO loading of scrap during this period

- **BUCKET LOADING** - showing that the system is ready to monitor the scrap being loaded - the external Traffic Light goes GREEN to advise the crane operator to being loading

See Section 4.5 and 4.6 below for more information on these system STATUS functions.

4.5 NORMAL SYSTEM OPERATION - SUMMARY



LABEL								

A-B - WAIT - in this period the GR-526C is ready for monitoring - system local background is being computed and continuously updated

B-C - TRANSIT - the first OS sensor has been activated to show that the bucket is entering the system - local background updating is suspended

C-D - SETTLE - the bucket SETTLING TIME (a parameter setting) - this is a variable period (usually 10-20 secs) used to ensure that the bucket has stopped before analysis can start

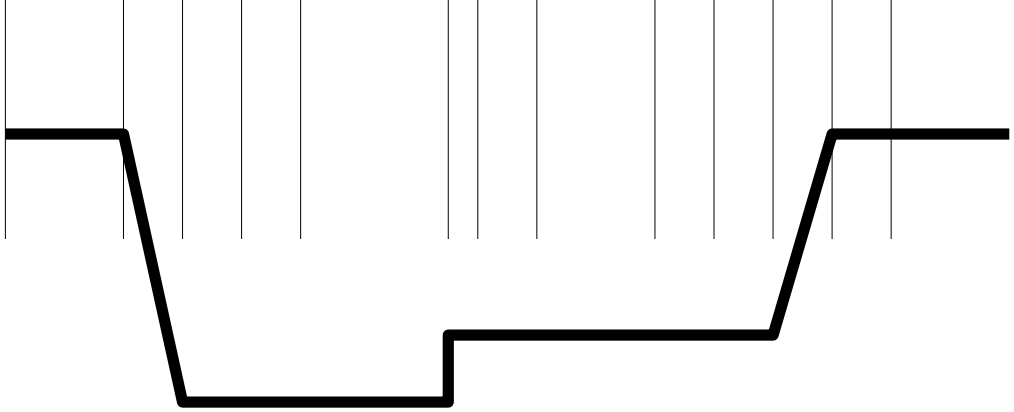
D-E - SETUP - this is the system “setup” period (set by the SAMPLE PERIOD parameter) where the individual Bucket-In background level is computed and alarm thresholds computed and set

E-F - MONITOR - during this time the Bucket is loaded with scrap and continuous Alarm analysis occurs

F-G - TRANSIT - one OS is de-activated so the bucket is leaving

G-H- BG UPDATE - both OS are de-activated so the bucket has left and the system is computing a new local Background reading - time period set by SETTLING TIME parameter

H+WAIT - system is now ready to monitor another bucket



OPERATION - SUMMARY

	A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K	K-L	L-M	M+
	WAIT	**TRANS**	**SETTLE**	**SETUP**	**MONIT**	**ALARM**	**ALARM**	**ALARM**	**RETEST**	**WAIT**	**TRANS**	**UPDATE**	**WAIT**
GREEN Traffic Light	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
YELLOW Traffic Light	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON
RED Traffic Light	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
External HORN	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
Internal AUDIO	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
Red ALARM Button	OFF	OFF	OFF	OFF	OFF	OFF	ON	FLASH	FLASH	FLASH	FLASH	OFF	OFF
Yellow STATUS Light	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
526 Display LABEL	**SYSTEM READY**	**BUCKET >IN**	**BUCKET IN**	**BUCKET IN**	**BUCKET LOADING**	**WAIT**	**ALARM/ RETEST**	**BUCKET LOADING**	**BUCKET >IN**	**WAIT**	**WAIT**	**BG UPDATE**	**SYSTEM READY**

A-B - WAIT - in this period the GR-526C is ready for monitoring - system local background is being computed and continuously updated

B-C - TRANSIT - the first OS sensor has been activated to show that the bucket is entering the system - local background updating is suspended

C-D - SETTLE - the bucket SETTLING TIME (a parameter setting) - this is a variable period (usually 10-20 secs) used to ensure that the bucket has stopped before analysis can start

D-E - SETUP - this is the system “setup” period where the individual Bucket-In background levels is computed and alarm thresholds computed and set (parameter setting SAMPLE PERIOD).

E-F - MONITOR - Bucket loading can now commence, system continuously in alarm detection mode. In this mode the most sensitive alarm level - LEVEL 1 - is scanned at a 1/sec data rate - and LEVEL 2 a less sensitive alarm threshold level is scanned at a 0.1 sec data rate.

F-G - ALARM - a potential alarm has been detected, GREEN light goes OFF to advise users to suspend loading. Note thta the audio/visual warning are NOT activated at this time as the system goes threoiugh an additional evaluation to automatcilaly confirm (or reject) the alarm. (Level 1 alarm requires 5 SUCESIVE seconds above the computed alarm threshold whereas a Level 2 alarm requires a seelcted number (NUMBER parameter) of 0.1 sec data points above the computed alarm thresho;ld before an alarm is declared.

G -H ALARM - the alarm is confirmed, audio/visual warnings occur

H-I - **ALARM** - the user studies the alarm displays and decides on the correct action - usually a RETEST

I-J - RETEST - another alarm analysis is carreid out to verify the alarm - after this time if the alarm is confirmed then the bucket must be removed and the radioactoive material recovered.

J-K - ALARM - user decides on correct action (usually Buacket removal)

K-L - Bucket is removed then once clear of the deettcors “STOP” is pressed (follwoings creen prompts) to restart the stayetem ready to test the next bucket

L-M - **UPDATE** - the local background levels are computed

M+ - System is ready to test the next bucket

4.7 TRAFFIC LIGHTS

It is essential that a traffic Light system is installed to advise the CRANE operator of system status and to guide in correct actions, the above tables define light action, basic traffic light signals are specified below.

YELLOW - system ready to monitor
NO LIGHTS - wait

GREEN - start bucket loading

NO LIGHTS - stop loading (wait)

RED - Radiation alarm

4.8 ALARM DISPLAYS AND PROCEDURES

4.8.1 IF AN ALARM OCCURS

When the GR-526C determines that a bucket's radiation level is above its computed threshold, the following alarm sequence is automatically initiated by the system :

ALARM RECORD - the alarm is stored in system MEMORY

AUDIO ALARM - the console mounted AUDIO ALARM sounds

ALARM BUTTON - the console mounted red **ALARM** button lights

DISPLAY - the Console Display changes to the ALARM DISPLAY to display the alarm details (Fig 6).

EXTERNAL **HORN** - the external HORN sounds if connected

RED TRAFFIC LIGHT - the external red traffic light turns **ON**

4.8.2 RADIATION ALARM DISPLAY

If a **RADIATION ALARM** occurs, the Audio gives a loud <u>continuous</u> tone and the display changes to show the alarm (Fig 8). The Audio alarm will continue <u>indefinitely</u> until the RED **ALARM** button is pressed. In the Alarm Display various data are displayed (all data in counts/sec - cps) :

Out - 5239 5345 Local Radiation Background as seen on the A and B detectors

Zero -3591 3604 Empty bucket radiation level

In -	**3607 3623**	Current bucket radiation level prior to the alarm
Th -	**4730 4760**	Computed Alarm Threshold level
Min -	**3000 3140**	Minimum radiation level during monitoring period
Max -	**6160 6200**	Maximum radiation level during monitoring period

The last 2 lines of data are encoded to report system status - see Section 8.10.

REFER TO FIG. 15 FOR AN ALARM FLOW DIAGRAM

4.8.3 ALARM PRINTOUT

When the red **ALARM** button is pressed to silence the audio alarm, the internal system printer (if selected during setup) creates a hard-copy printout of the alarm as shown in Fig. 9.

This is the same numeric data as was shown on the display. The last 2 lines of data are encoded to report system status.

The numeric data is explained in 4.8.2 above.

4.8.4 "LONG" ALARM PRINTOUT

If a special "ALARM DETAILS" option is selected during SETUP (see Section 9.20), the actual numeric data that caused the alarm is added to the alarm printout as shown in Figure 10.

The upper data is explained in 4.8.2 above

The lower data is the actual count data (in counts/second) for each detector (in this case A and B). The number of lines of data

is a variable depending on the system alarm status but at all times the numeric data is sufficient to explain the alarm status.

4.8.5 ALARM RE-TEST

With the Audio alarm stopped, pressing the red **ALARM** button again (a second time) will cancel the Alarm Display and the system will go to a special display screen - Fig 11.

ALARM STORED

Press **RUN** to retest Alarm

Press **STOP** to continue normal operation

Correct actions must be determined by Plant Response Procedure - the selections are:

RUN - this permits the alarm to be retested

STOP - this erases the data that caused the alarm and the system starts monitoring again.

NOTE : this screen will stay displayed continuously until the user selects the correct action.

4.8.5.1 RUN

Normally the alarm is retested to get an idea of where the source is located and to confirm the alarm. When **RUN** is pressed, the Monitoring Display (Fig 5) is seen and the **"STATUS"** display label shows **ALARM RETEST**. The results of this retest can be:

j. ALARM again - follow the same sequence as 4.8.4 and 4.8.5 above.

b) NO ALARM - in which case the system goes back to the BUCKET LOADING and the system is ready for use again.

4.8.5.2 STOP

If this selection is made, an additional screen appears - Fig. 12

STOP - the user is stating that all radioactive material has been removed so the system can start monitoring again looking for additional sources.

RUN - the user wants to repeat an alarm assessment

```
*******>>WARNING<<<******
*  Are you sure that the      *
*  SOURCE has been removed?   *
*                             *
*  if YES press STOP again    *
*  if NO press RUN            *
*****************************
```

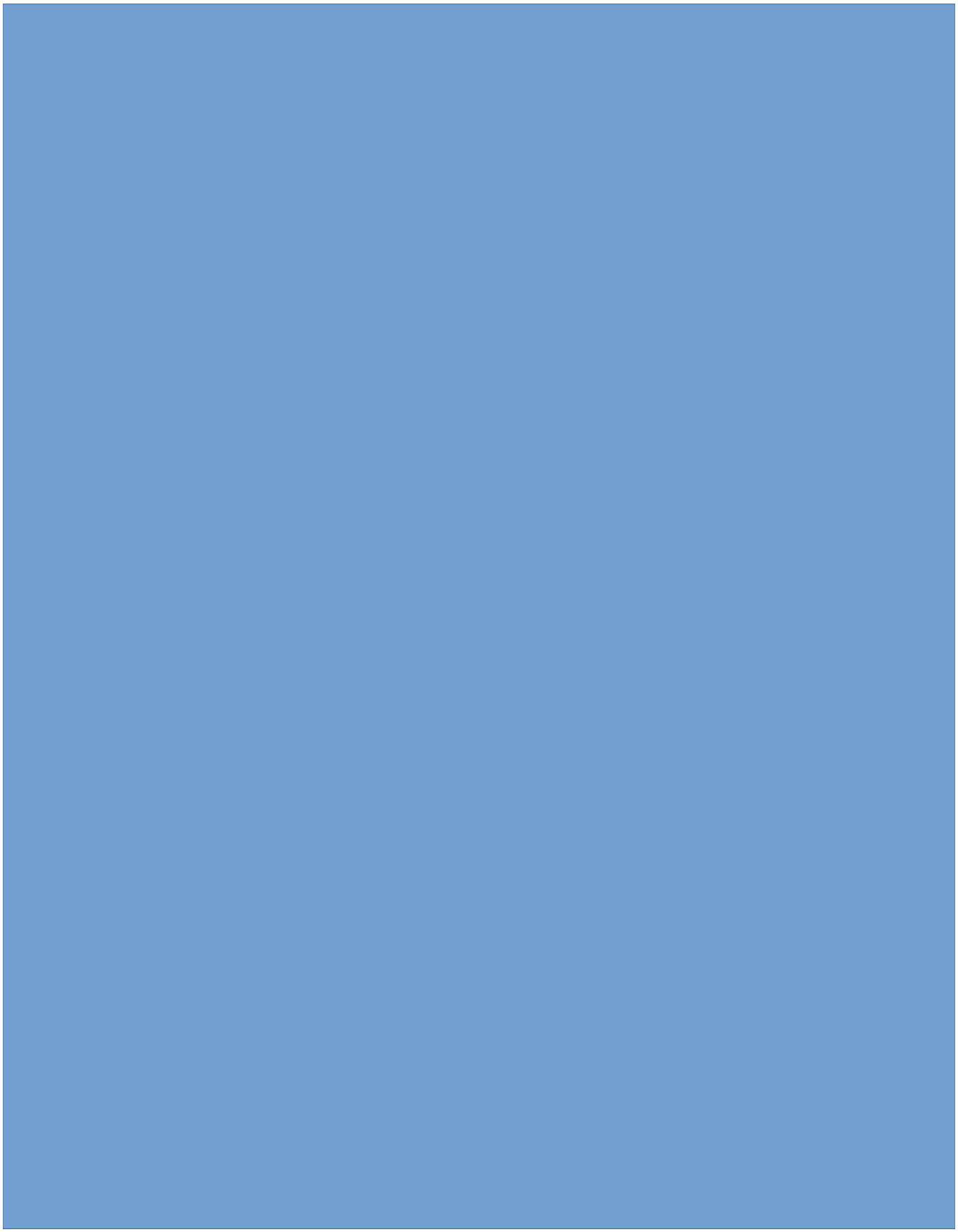
See the Flow diagram below for a better understanding of these procedures.

4.8.6 DANGER ALARM

DANGER ALARM is a special Alarm level that could denote hazardous material with a potential personnel exposure hazard. For this reason it has a special display (Fig 13) and printout (Fig 14).

If this screen appears, press **ALARM** to silence the audio, and the screen will replace the message “Press ALARM to silence HORN”with “**proceed with caution”**.
Correct procedure depends on the plant but normally the bucket area should be evacuated and the RSO should survey the area with a hand-held instrument to assess the actual situation.

4.8.7 ALARM FLOW CHART



4.8.8 PRINTING ALARMS

The GR-526C will store up to 30 typical alarms in memory, however VERY LONG

alarms can limit the number of alarms stored. An alarm access password is built into the system to allow an authorized user to review stored alarms. This password is different from the Maintenance password. (See section 6.27)

The alarm password is: **<ENTER - 1 - 4 - 9 - 2 - ENTER>**. Once entered, the following screen appears.

cc - is a cursor used to select an alarm by using the UP and DOWN arrow

- is a sequential # starting at 1 to label the alarm. This number increases to 99 then resets to 1

Date - is the Date that the alarm occurred

```
cc
          ***** A L A R M S *****
 #       Date          Time     Level     Size
-----------------------------------------------
 1      4-26-96    02:11:21    L2A       123
 2      4-26-96       05:18:11    L2A         96
 3      4-26-96    09:01:22    D5Z        48
 4      4-26-96    12:11:21    H2A        78
 5      4-26-96       12:18:11    H2A       199
 6      4-26-96       13:01:22    L1A        22
 7      4-26-96    15:01:22    L1B        57
 8      4-26-96    20:11:21    L1A        94
 9      4-26-96    21:18:11    L1A        27
10      4-26-96    22:09:36    L1b        55
-----------------------------------------------
```

Time - is the TIME that the alarm occurred

Level - is the Alarm LEVEL. There are various data here as follows :

L2A - **L** = LOW level alarm - **2** = LOW Alarm L2
A(B) = primarily on detector A(B), **a** = Test Alarm

D5Z - **D** = DANGER alarm - **5** = Alarm level 5
Z = ALL detectors

Size - the number of samples for each bucket analysis. This parameter is usually only useful to Exploranium.

Pressing "**1**" while viewing this display will print a listing of the alarms in memory on the internal printer. Alarms are printed as follows:

The ARROW keys are used to select an alarm then pressing **<ENTER>**, displays the actual data from the Alarm, exactly as the user would have seen it as it occurred (Fig. 8). Note that Alarm # 10 (marked **L1b**) is a Level 1 Alarm and is a RE-TEST Alarm. Alarms that are the result of a RETEST are flagged in this manner to help subsequent data analysis.

NOTE : FOR SPECIAL ALARM (D5Z) SEE SECTION 4.8.6

DANGER DISPLAY -

PRINT ALARMS

Press <**1>** to print out the selected alarm. The following are the explanation of the alarm printout parameters shown in Fig 17.

Out - 5239 5345 Local Radiation Background as seen on the A and B detectors

Zero -3591 3604 Empty bucket radiation level

In - 3607 3623 Current bucket radiation level prior to the alarm

Th - 4730 4760 Computed Alarm Threshold level

Min - 3000 3140 Minimum radiation level during monitoring period

Max - 6160 6200 Maximum radiation level during monitoring period

5.0_MONITOR-WHILE-FULL - (Mode =1-6)

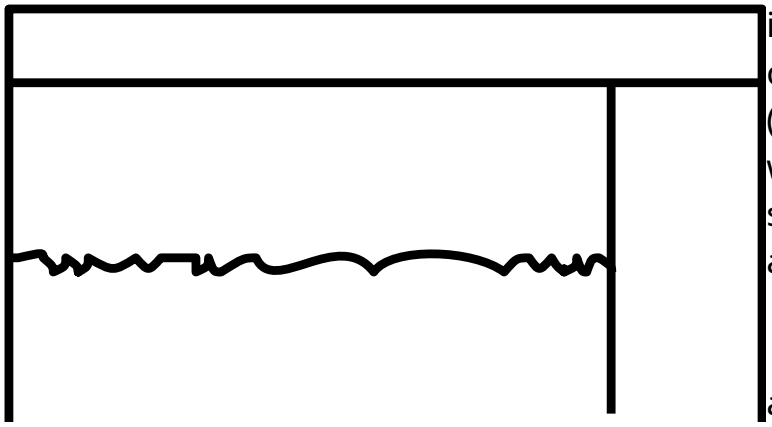
5.1 SYSTEM OPERATION - QUICK START

The following assumes that the GR-526C has been connected correctly, Exploranium Service Department personnel have supervised Start-Up and set all operating parameters correctly.

Note that except for ERRORS and ALARMS - NO USER ACTION IS REQUIRED as system operation is fully automatic.

5.2 NORMAL DISPLAY (NO BUCKET IN PLACE)

The normal (BUCKET OUT) console display is shown in Fig. 8. During normal operation the screen is **DARK** (pressing any key switches it on), when a bucket enters the system detectors the screen automatically "lights up".



The message at the top of the display should say **SYSTEM READY** showing that the system is ready for monitoring if a bucket is entered.

5.3 SYSTEM ERRORS

If the system detects a serious INTERNAL problem it advises the user with an audio "quick-beep" (3/sec rate). The user should press the **STATUS** front panel BUTTON to acknowledge this warning and advise Maintenance of the **WARNING MESSAGE** display on the Console Display in the location indicated on Fig. 8.

.

5.4 SINGLE or MULTIPLE sized Buckets

SINGLE : If only 1 bucket size is used then operation is fully automatic (except for errors and alarms as noted above).

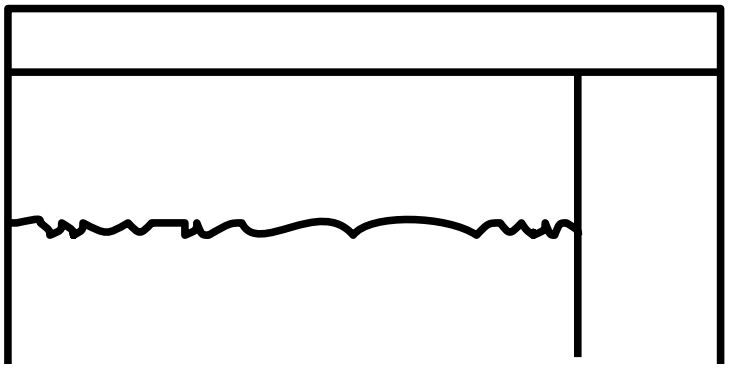
MULTIPLE : If the system is configured to analyse MULTIPLE bucket sizes (up to 6 sizes) then the user must SELECT bucket type as shown on a special display (Fig. 9) before analysis can take place.

The user must press numeric keys 1-6 as required (numeric key assignments to a particular Bucket Type are done during system setup by Exploranium personnel in conjunction with user requirements)

NOTE : If more than 60 seconds goes by WITHOUT bucket selection, the console will “beep” as a reminder and this ‘beeping’ will only stop when the correct button selection is made.

5.5 NORMAL DISPLAY - when a BUCKET is being MONITORED

During BUCKET-IN monitoring - the STATUS message shown on Fig. 10 indicates the current status of system operation.

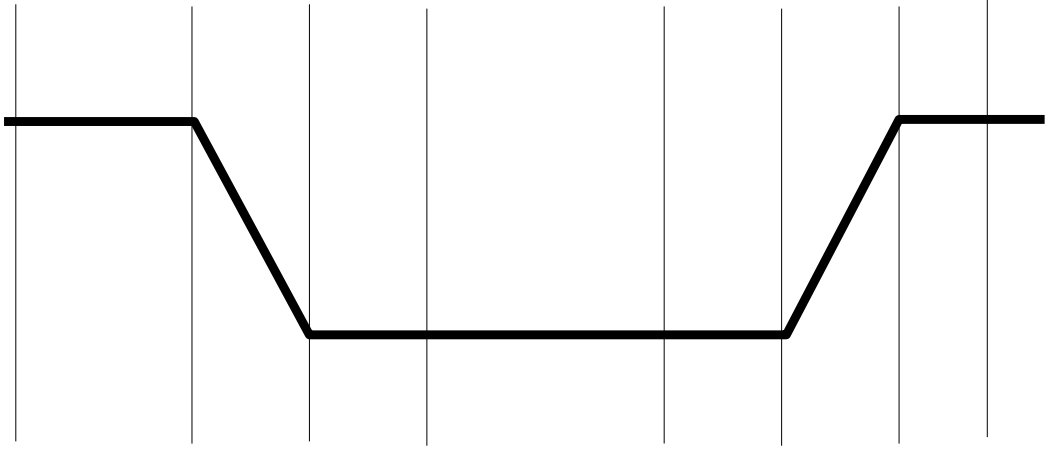


Messages may be :

- **BUCKET > IN** - showing that 1 of the OS units has been activated and the Bucket is moving IN.

- **BUCKET IN** - showing that the Bucket is now correctly in place and system parameters are being analysed - NO loading of scrap during this period

- **BUCKET LOADING** - showing that the system is ready to monitor the scrap being loaded - the external Traffic Light goes GREEN to advise the crane operator to being loading



See Section 5.6 and 5.7 below for more

information on these system STATUS functions.

5.6 NORMAL SYSTEM OPERATION - SUMMARY

	A-B	B-C	C-D	D-E	E-F	F-G	G-H	H+
Mode	**READY**	**TRANSIT**	**SETTLE**	**MONITOR**	**WAIT**	**TRANSIT**	**WAIT**	**READY**
GREEN Traffic Light	ON	OFF	OFF	OFF	ON	ON	OFF	ON
YELLOW Traffic Light	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
RED Traffic Light	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
External HORN	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Internal AUDIO	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Red ALARM Button	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Yellow STATUS Light	ON	ON	ON	ON	ON	ON	ON	ON
STATUS Display LABEL	**SYSTEM READY**	**BUCKET >IN**	**BUCKET IN**	**WAIT 30, 29... MONITORING BUCKET**	**BUCKET MONITORED**	**BUCKET MONITORED**	**BG-UPDATE WAIT**	**SYSTEM READY**

A-B - WAIT - in this period the GR-526C is ready for monitoring - system local background is being computed and continuously updated

B-C - TRANSIT - the first OS sensor has been activated to show that the bucket is entering the system - local background updating is suspended

C-D - SETTLE - the bucket SETTLING TIME - this is a variable period (usually 10-20 secs set by the SETTLING TIME parameter) that starts after BOTH O.S. are covered, used to ensure that the bucket has stopped before analysis can start

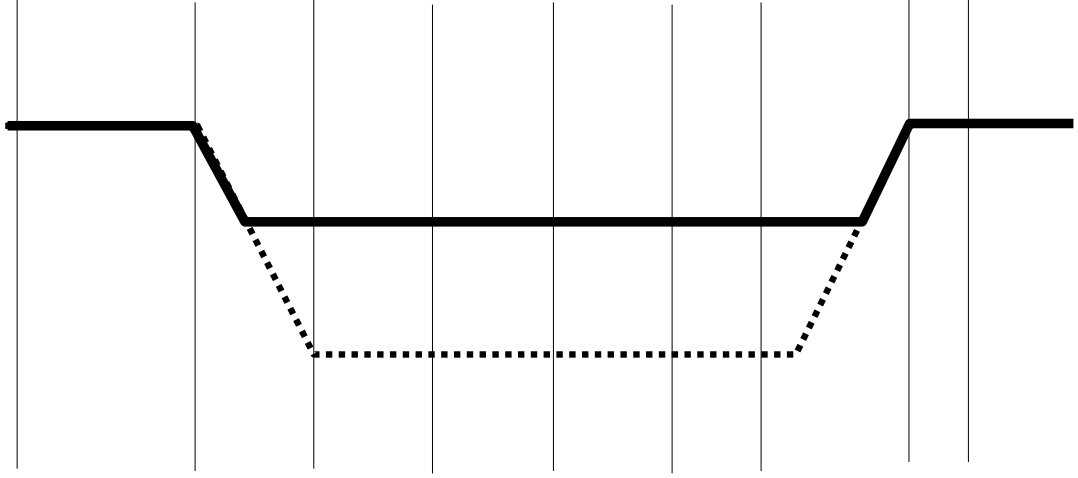
D-E - MONITOR - during this time the loaded Bucket is analysed for radiation - a countdown of time before the analuysis is complete is shown on the display (30, 29, 28...3, 2, 1)

E-F - WAIT - Alarm analysis is complete and the user is advised to remove the bucket

F-G - TRANSIT - one OS is de-activated so the bucket is leaving

G-H- BG UPDATE - both OS are de-activated so the bucket has left and the system is computing a new local Background reading

H+WAIT - system is now ready to monitor another bucket



OPERATION - SUMMARY

	A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I+
	READY	**TRANS**	**SETTLE**	**MONITOR**	**ALARM**	**ALARM**	**ALARM**	**TRANSIT**	**READY**
GREEN Traffic Light	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
YELLOW Traffic Light	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
RED Traffic Light	OFF	OFF	OFF	OFF	ON	ON	FLASH	FLASH	OFF
External HORN	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
Internal AUDIO	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
Red ALARM Button	OFF	OFF	OFF	OFF	ON	FLASH	FLASH	FLASH	OFF
Yellow STATUS Light	ON	ON	ON	ON	ON	ON	ON	ON	ON
526 Display LABEL	**SYSTEM READY**	**BUCKET >IN**	**BUCKET IN**	**WAIT 30 (29..) MONITORING BUCKET**	**ALARM DISPLAY**	**ALARM DISPLAY**	**ALARM/ RETEST**	**BG UPDATE**	**SYSTEM READY**

A-B - WAIT - in this period the GR-526C is ready for monitoring - system local background is being computed and continuously updated

B-C - TRANSIT - the first OS sensor has been activated to show that the bucket is entering the system - local background updating is suspended

C-D - SETTLE - the bucket SETTLING TIME - this is a variable period (usually 10-20 secs) used to ensure that the bucket has stopped before analysis can start

D-E - MONITOR -Bucket analysis for a preset period of time (Display shows countdown to analysis completion 30, 29...2,1).

E-F - ALARM - analysis complete and alarm declared

F-G - ALARM - after pressing the ALARM button, the audio is cancelled and user can inspect the display

G -H ALARM - after user analysis is complete the display advises the user to press STOP and remove the bucket

H-I - **UPDATE -** the bucket is out and the background levels are being updated

I+ - READY - the system is avaliable to analyse the next bucket

5.8 TRAFFIC LIGHTS

It is essential that a traffic Light system is installed to advise the CRANE operator of system status and to guide in correct actions, the above tables define light action, basic traffic light signals are specified below.

GREEN - system ready to monitor
YELLOW - system monitoring
RED - Radiation alarm

5.9 ALARM DISPLAYS AND PROCEDURES

5.9.1 IF AN ALARM OCCURS

When the GR-526C determines that a bucket's radiation level is above its computed threshold, the following alarm sequence is automatically initiated by the system :

ALARM RECORD - the alarm is stored in system MEMORY

AUDIO ALARM - the console mounted AUDIO ALARM sounds

ALARM BUTTON - the console mounted red **ALARM** button lights

DISPLAY - the Console Display changes to the ALARM DISPLAY to

display the alarm details (Fig 23).

EXTERNAL **HORN** - the external HORN sounds if connected

RED TRAFFIC LIGHT - the external red traffic light turns **ON**

5.9.2 RADIATION ALARM DISPLAY

If a **RADIATION ALARM** occurs, the Audio gives a loud <u>continuous</u> tone and the display changes to show the alarm (Fig 23). The Audio alarm will continue <u>indefinitely</u> until the RED **ALARM** button is pressed. In the Alarm Display various data are displayed (all data in counts/sec - cps) :

Out - 5239 **5345**
Local Radiation Background
as seen on the A and B detectors
In - 3607 **3623**
Computed bucket
radiation level if no alarm
Th - 4730 **4760**
Computed Alarm Threshold
level
Max - 6160 **6200**
Maximum radiation level during monitoring period

The last 2 lines of data are encoded to report system status - see Section 8.10

REFER TO FIG. 29 FOR AN ALARM FLOW DIAGRAM

5.9.3 ALARM PRINTOUT

When the red **ALARM** button is pressed to silence the audio alarm, the internal system printer (if selected during setup) creates a hard-copy printout of the alarm as shown in Fig. 24.

This is the same numeric data as was shown on the display. The last 2 lines of data are encoded to report system status.

The numeric data is explained in 5.9.2 above.

5.9.4 ALARM RE-TEST

With the Audio alarm stopped, pressing the red **ALARM** button again (a second time) will cancel the Alarm Display and the system will go to a special display screen - Fig 25.

ALARM STORED

Press **RUN** to retest Alarm

Press **STOP** to continue normal operation

Correct actions must be determined by Plant Response Procedure - but in principle the selections are:

RUN - this permits the alarm to be retested

STOP - this erases the data that caused the alarm and the system starts monitoring.

NOTE : this screen will stay displayed continuously until the user selects the correct action.

5.9.4.1 RUN

Normally the alarm is retested to get an idea of where the source is located and to confirm the alarm. When **RUN** is pressed, the Monitoring Display (Fig 5) is seen and the **"STATUS"** display label shows **ALARM RETEST**. The results of this retest can be:

c) ALARM again - follow the same sequence as 5.9.4 and 5.9.5 above.

b) NO ALARM - in which case the system goes back to the BUCKET LOADING and the system is ready for use again.

5.9.4.2 STOP

If this selection is made, an additional screen appears

```
*******>>WARNING<<<******
*  Are you sure that the      *
*  SOURCE has been removed?   *
*                             *
*  if YES press STOP again    *
*  if NO press RUN            *
*******************************
```

STOP - the user is stating that all radioactive material has been removed so the system can start monitoring again looking for additional sources.

RUN - the user wants to repeat an alarm assessment

See the Flow diagram below for a better understanding of these procedures.

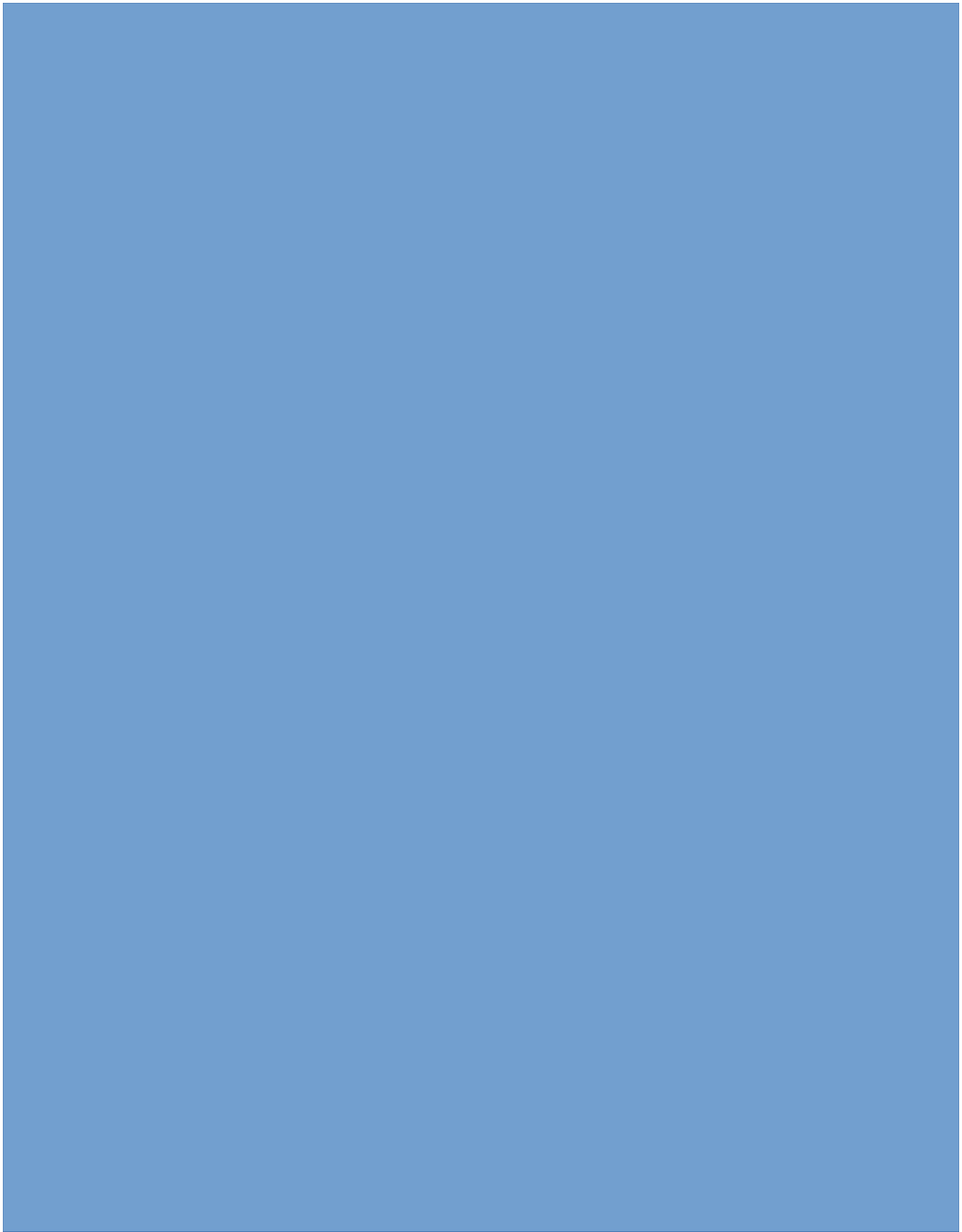
5.9.5 DANGER ALARM

DANGER ALARM is a special Alarm level that could denote hazardous material with a potential personnel exposure hazard. For this reason it has a special display (Fig 27) and printout (Fig 28).

If this screen appears, press **ALARM** to silence the audio, and the screen will replace the message “Press ALARM to silence HORN”with “**proceed with caution”**.

Correct procedure depends on the plant but normally the bucket area should be evacuated and the RSO should survey the area with a hand-held instrument to assess the actual situation.

5.9.6 ALARM FLOW CHART



5.9.7 PRINTING ALARMS

The GR-526C will store up to 30 typical alarms in memory, however VERY LONG alarms can limit the number of alarms stored. An alarm access password is built into the system to allow an authorized user to review stored alarms.

The alarm password is: **<ENTER - 1 - 4 - 9 - 2 - ENTER>**. Once entered, the following screen appears.

cc - is a cursor used to select an alarm by using the UP and DOWN arrow

- is a sequential # starting at 1 to label the alarm. This number increases to 99 then resets to 1

Date - is the Date that the alarm occurred

```
                ***** A L A R M S *****
 #       Date          Time     Level     Size
 ----------------------------------------------
 1      4-26-96    02:11:21    L2A       123
 2      4-26-96       05:18:11    L2A        96
 3      4-26-96    09:01:22    D5Z        48
 4      4-26-96    12:11:21    H2A        78
 5      4-26-96       12:18:11    H2A       199
 6      4-26-96       13:01:22    L1A        22
 7      4-26-96    15:01:22    L1B        57
cc 8    4-26-96    20:11:21    L1A        94
 9      4-26-96    21:18:11    L1A        27
10      4-26-96    22:09:36    L1b        55
 ----------------------------------------------
```

Time - is the TIME that the alarm occurred

Level - is the Alarm LEVEL. There are various data here as follows :

L2A - **L** = LOW level alarm - **2** = LOW Alarm L2
A(B) = primarily on detector A(B), **a** = Test Alarm

D5Z - **D** = DANGER alarm - **5** = Alarm level 5
Z = ALL detectors

Size - the number of samples for each bucket analysis. This parameter is usually only useful to Exploranium.

Pressing "**1**" while viewing this display will print a listing of the alarms in memory on the internal printer. Alarms are printed as follows:

The ARROW keys are used to select an alarm then pressing **<ENTER>**, displays the actual data from the Alarm, exactly as the user would have seen it as it occurred (Fig. 31).

NOTE : FOR SPECIAL ALARM (D5Z) SECTION 5.9.5

DANGER DISPLAY - SEE

6.0_MONITOR-WHILE-LOADING - (Mode =8)

6.1 SYSTEM OPERATION - QUICK START

The following assumes that the GR-526C has been connected correctly, Exploranium Service Department personnel have supervised Start-Up and set all operating parameters correctly.

Note that except for ERRORS and ALARMS - NO USER ACTION IS REQUIRED as system operation is fully automatic.

The significant difference between normal Mode=0 =MONITOR-WHILE-LOADING (Section 4.0) and this “special” mode = Mode = 8 - is that for Mode = 0 the Bucket is monitored while covering the Optical sensors whereas in the “special” mode - MODE=8 - Optical sensor activation shows that the Bucket is in transit and actual monitoring takes place AFTER THE BUCKET HAS CLEARED THE OPTICAL SENSORS (in the correct direction). Special sensor logic ensures that the system keeps track of whether the Bucket is moving IN and requires monitoring or is moving OUT and monitoring must be terminated.

Operation is essentially identical to MODE=0 - the only visible difference is that if an alarm is designated “ALARM LEVEL 1C (or 2C) that the “C” detetcor is the TOP-UP Detector wherase aalrms labelled “A” or “B” are form the A,B deettcors of the normal MONITOR-WHILE-FULL installation.

7.0 OPERATION - Detailed

The following section is a detailed look at how the system works and gives details of special operational selections that may be selected during system setup. Refer to Section 9 for actual PARAMETER settings and relevant details.

7.1 POWER SWITCH

The YELLOW GR-526C power switch is located inside the system console and can be reached from the lower right-hand access door. Access to the power switch has deliberately been made difficult to minimize the chance of unauthorized personnel interfering with system operation.

7.2 STARTUP SCREEN

When power to the GR-526C is turned on, the following screen appears on the Console Display:

EXPLORANIUM GR-526C

Radiation Monitor

Serial # - 1234 8V46

Test in progress - WAIT

This startup screen is displayed for a few seconds while all components of the GR-526C system are automatically tested. If all parts of the system are working correctly, the Console Display will change to show the Monitoring Display (Fig 33) and the following message will be printed on the printer

RESXX - 02/14/93 - 14:23:00 -

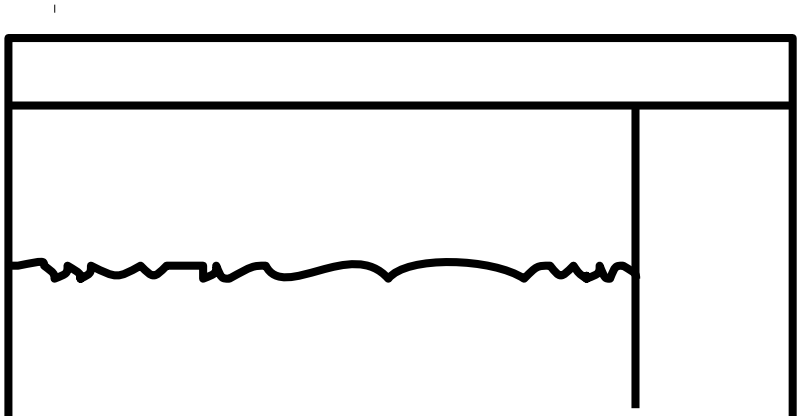
(date) (time)

XX represents a diagnostic code for performance analysis

If any faults **ARE** detected, the errors are displayed - see Section 7.4 for details.

7.3 MONITORING DISPLAY

During normal monitoring (no Alarms), the Console Display is divided into three blocks that present information to the user (Fig. 33).



At the top of the Console Display is the STATUS block. In this area the Time, Speed, Date and system status are displayed.

The lower left block contains a chart recorder display that shows radiation levels for the past five minutes plus any INFORMATION Messages.

The lower right block displays the scale of the Chart Recorder display as well as the current average radiation level and some additional SPECIAL Messages.

7.4 DISPLAY MESSAGES

The CONSOLE DISPLAY is used to alert the user to any problem with the system and to display system messages advising the user of the current status of system performance.

In the table below all messages are listed -

Status - means the position of the STATUS (Yellow) button on the

console

STATUS - means press the STATUS button and notify Maintenance
Traffic - means the status of the Traffic Light output (if used)
Audio - the action of the console internal audio buzzer
User action - is recommended user actions
Message - information messages on the Display

Message	**STATUS**	**Traffic**	**Audio**	**User action**	**Comments**
SYSTEM WARMUP - WAIT	Flash	flashing YELLOW	None	None	Typically 30 second wait on system startup
SYSTEM READY	ON	YELLOW	None	None	Ready to monitor
BUCKET IN>	ON	YELLOW	None	None	Bucket entering
BUCKET IN	ON	YELLOW	None	None	Bucket in place
BUCKET LOADING	ON	GREEN	None	None	Bucket can be loaded
BG UPDATE-WAIT	ON	YELLOW	None	None	System computing background data
ALARM RETEST	ON	RED	None	None	Alarm is being retested
TELE-MAINTENANCE	ON	GREEN	None	None	Modem access occurring
OS1 ERR (or OS2 ERR)	Fast Flash	flashing YELLOW	Fast beep	Press **STATUS**	Optical Sensor defective
OS1,2 ERR	Fast Flash	flashing YELLOW	Fast beep	Press **STATUS**	BOTH OS defective
IS BUCKET IN?	Fast Flash	flashing YELLOW	Fast beep	Press **STATUS**	Message to check if OS are blocked
Detector ERR A1, cntr 123	Fast Flash	flashing YELLOW	Fast beep	Press **STATUS**	A detector is defective
COMM FAILURE A	Fast Flash	flashing YELLOW	Fast beep	Press **STATUS**	Detector A Comm problem
COMM ERROR A	Fast Flash	flashing	Fast	Press	Detector A

Message	**STATUS**	**Traffic**	**Audio**	**User action**	**Comments**
		YELLOW	beep	**STATUS**	Comm problem
SYSTEM INOPERABLE	Fast Flash	RED	Fast beep	Stop monitoring + call Maintenanc e	System is dead
Modem I/O error	Fast flash	YELLOW flash	Fast beep	Press **STATUS**	Defective modem

7.5 TRAFFIC LIGHT SYSTEM

The GR-526C is supplied with a TLC (Traffic Light Controller). Exploranium specifies that this system must be installed to permit correct operation of the system. There are 4 control lines available and are usually connected to : **GREEN**, **YELLOW** and **RED** lights and an external **HORN**. The System Flow diagrams in Section 4 and 5 fully define the various traffic light conditions.

7.6 HISTORY/LOG FILES

The GR-526C has a TWO special internal record of system action as an aid to Maintenance and proper system operation. These files are referred to as “HISTORY FILE” and “BUCKET LOG FILE” and are accessible by entering a special Password and the data may be displayed and/or printed.

However the data CANNOT be erased as it is primarily intended to permit detailed system analysis and to prevent incorrect procedures. The file is limited to **100 records** and to avoid any potential confusion the DATE FORMAT is fixed as US format and cannot be changed.

The user is permitted to mark the **START** and the **END** of the section of interest, and then the selected section can be printed. The **END** point selected is stored and the next time the user enters this screen the previous **END** is now automatically set as the new **START** ,and the current end is marked as **END**. Thus it permits users to

print out the current data very simply. Users can then use this information as a control on # of speed alarms etc.

When the password <**9 - 1 - 9 -1 - ENTER**> is entered the History File appears as follows:

7.6.1 HISTORY DISPLAY

The display permits marking of selected text and printing blocks of data as follows :

<UP/DOWN> permits users to use the UP/DOWN arrow keys to select Start and End points to define a data block

<1> once the cursor is positioned at the selected position, press **1** on the keyboard to mark this point. The screen shows **BEG** (Beginning).

<ENTER> accepts this mark as the BEG point. NOTE : that if the user wants the History File data FROM THE LAST TIME IT WAS PRINTED, pressing **ENTER** immediately on entering this screen marks only the current data.

The screen now changes and other info is displayed.

<2> the arrows keys should be used to mark the end point of the data and when **2** is pressed, this point is marked as **END** = the end point of the data block.

<CLEAR> will clear the selected points and you can start again

<9> prints this selected data block

<STOP> return to Monitoring

```
********* HISTORY FILE *********
#    Event     Date     Time
BEG  AL1       10/05/96 12:03:29
2    RES05     10/05/96 12:14:13
3    STAT      10/05/96 12:17:13
4        1041011060 6       0004211U
5    AL2       10/05/96 12:20:26
6    SETUP     10/05/96 12:25:04
END      RES01    10/05/96 12:25:19
-------------------------------------------------
       EOF   SN:4321      S/W:8.42
-------------------------------------------------
<UP/DOWN> Move  <1> Mark begin
<ENTER> Confirm  <STOP> exit
```

For a description of the data displayed, see the explanation below.

7.6.2 HISTORY PRINTOUT

A typical printout of a selected block is as follows:

```
     ***** HISTORY FILE  *****
AL1         10/05/96  12:03:29
RES05    10/05/96  12:14:13
STAT 10/05/96  12:17:13
    1041011060 6   0004211U
AL2         10/05/96  12:20:26
SETUP    10/05/96  12:25:04
RES01    10/05/96  12:25:19
 ------------------------------------
EOF   SN:4321  S/W:8.42
------------------------------------
```

RES05 - the GR-526C has many automatic resets that restore the system in the event of various system faults or special conditions. These resets can give a very clear idea of a potential problem so they are numbered for analysis. See Appendix F for a full list.

STAT -
1041011060 6 0004214U is the current list of system parameters

Alarm Records

AL 1 -This is a record that an alarm occurred and this is sequential **Alarm # 1**.

Other labels
SETUP - a record that a user has accessed the system to change system parameters. Any changes of parameter must be very carefully regulated or system performance could easily be compromised.

REMOT -this record shows that the system was accessed remotely by an external computer OR system automatically notified the Exploranium Service computer of errors.

STAT shows that the user selected the Current Parameters printout - see Section 4.12)

COMFx - (x=A,B,C,D) - COMM.FAILURE in indicated detector

COMEx -(x=A,B,C,D) - COMM.ERROR in indicated detector

SETDT - date/time changed by user

PwOFF - Power OFF event

7.6.3 BUCKET LOG DISPLAY

Entering the Password **" ENTER - 9 - 1 - 9 - 2 - ENTER"** will display the Bucket Log display.

This display is used to check/compute correct system parameters and to assess system performance.

This display has 2 different modes depending on **Bk HIST** parameter selection - DAILY or UNIT as described below.

7.6.3.1 DAILY (DEFAULT)

This feature is used to track how many buckets are monitored/day as a control method for plant personnel. 6AM is the time that 1 day is terminated - to try to suit most plants shift timing.

Fig 36 illustrates this and is interpreted as follows :

```
      *****BUCKET LOG FILE *********
#     Event     Date      Time
BEG   B 000     5/21/97   12:00:00
2       B 002     5/22/97   12:16:59
3       B009      5/23/97   12:20:07
4       B021      5/27/97   12:22:01
-------------------------------------------------
        EOF   SN:4321      S/W:8.46
-------------------------------------------------
<UP/DOWN> Move   <1> Mark begin
<ENTER> Confirm   <STOP> exit
```

B 000 - this means that this feature was activated at the defined Date/Time. Note that this is the default setting so unless deliberately changed this selection is made. Note also that since this recording file has a limited number of entries (20) after 20 entries if the parameter is not changed then this message will be erased by the new records.

B 002 - this means on this DATE - only 2 buckets were analysed and the TIME is the time of the last bucket.

B 009 - 9 buckets on this date - etc.

S/N:4321 - Serial number of this system is #4321

S/W: 8.44 - Software version is 8V46

7.6.3.2 UNIT

This feature is usually used on system setup to assess system performance but sometimes is activated later if erratic performance is noted. Fig 37 illustrates this feature and contains TWO LINES for each bucket measured.

The data is interpreted as follows :

```
      *****BUCKET LOG FILE *********
#      Event      Date    Time
1       5157      10/05/96  12:20:07
        B 97C----D----A64B62C--D--
2       5239      10/05/96  12:22:13
        B 98C----D----A68B67C--D--
END
3         6773      10/05/96  12:31:13
        B 98C----D----A59B59C--D--
-------------------------------------------------
        EOF   SN:4321       S/W:8.46
-------------------------------------------------
<UP/DOWN> Move   <1> Mark begin
<ENTER> Confirm   <STOP> exit
```

5157 - the local radiation level seen by Detector A - BEFORE the bucket entered the OS system.

Date/Time - the Date/Time of the ENTRY of this bucket into the OS system

B97 - the local radiation level for Detector B - was 97% that of detector A = 5002

C-- - the local radiation for detector C - in this case not selected

D-- - the local radiation for detector D - in this case not selected

A64 - the Bucket IN radiation level for Detector A is 64% of Bucket A OUT = 3300

B62 - the Bucket IN radiation level for Detector B is 62% of Bucket B OUT = 3101

C--D-- - Background suppression of Detector C/D - not selected

From these data, Exploranium can carry out detailed performance analysis in case of system problems.

7.6.3.3 BUCKET LOG PRINTOUT

The data printout on the internal printer is exactly as shown on the display so the above description will fully explain this.

7.7 POWER OFF DURING AN ALARM

If the power goes OFF when an alarm is being displayed - when power is restored the
system goes back to the EXACT POINT at which the power failure occurred. As an example, if the Alarm sounds but the user does NOT press **ALARM** to silence the Audio before the power fails - when power is restored the Audio will again start and the console will return to the alarm display at the point that the power was lost.

SPECIAL CASE : If the user HAS silenced the audio and is viewing the alarm display screen when power is lost, when power is restored the system knows that the user has been advised of this alarm so on power up the system returns to the monitoring mode and display. At any time the user can view the alarms in memory by using the **< 1 4 9 2 >** password for entry.

7.8 PRINT CURRENT ALARMS

If Password **<5 - 5 - 5 - 5 - ENTER>** is pressed then the system will print all the alarms that have occurred SINCE THE LAST ALARM WAS PRINTED. A status message (**PrALA**) will appear on the display lower right box as a reminder that this feature has been activated. This printout may take some time as it is done on a **NON-INTERFERENCE** basis with normal system operation. Thus this printout DOES NOT STOP THE NORMAL SYSTEM MONITORING ACTIVITY.

If while this printing was occurring, a Radiation alarm occurs - then the Alarm takes priority and the current printing job is cancelled, and will have to be repeated later. However all alarms that have been completely printed have been "flagged" in the

system so they will not be repeated again.

7.9 PRINT CURRENT PARAMETERS

Press **<9 - 9 - 9 - 9 - ENTER>** is entered as a Password, then the current parameters + system status are output as follows on the printer.

When this feature is activated, a special message **PrSTA** appears on the lower right box of the main display as a reminder.

```
-------------------------------------------
CURRENT PARAMETERS    #4321
05/10/96                    12:53:27
SP=20    Av=4     ST=10    MOD=0
N=7      1=60     2 = 6
ERR =    0   0   0      Ver: 8.44
D=4      O=2      D=1   C=1   F=U
Poff:    05/10/96     13:49:15
-------------------------------------------
```

These data are defined as :

#4321 - is the Serial Number of the system

Date/Time - is the Date/Time of the printout

For the following data, a more detailed explanation of each parameter is given in Section 8.

SP=20 - Sample Period = 20 seconds
Av=4 - Data averaging = 4 minutes
ST=10 - Settling Time = 20 seconds
MOD=0 - System mode = 0 = Monitor-while-loading

N=7 - Number parameter - set to 7
1=60 - LOW Alarm L1 - set to 60 = 6.0SD
2=6 - LOW Alarm L2 - set to 6SD
ERR=000 Error Code (= current error messages see below)
Ver:8.44 Software Version - set to 8V46

D=4 - # of detectors - set to 4
O=2 - # of OS - set to 2
D=1 - Discriminators = 1 (normal)
C=1 - Special parameter - should be 1 unless system problems
F=U - Date format - set to U (US)

Poff Date/Time of last time system power was switched OFF

7.10 "ALARM" PARAMETER PRINTOUT

On the Alarm Printout (and the History File) the system parameters are listed in an encoded format, similar to when Current Parameters are printed. For clarity these codes are listed below.

Typical printout :

Sa	**A**	**Se**	**N**	**M**	**1**	**2A**	**B**	**C**	**8**	**4**	**4**	**D**	**O**	**D**	**C**	**F**
20	**4**	**20**	**1**	**0**	**60**	**6**			**0**	**0**	**0**	**4**	**2**	**1**	**1**	**U**

The top row is the PARAMETER CODE and the bottom row is the PARAMETER SETTING. The data is interpreted using the same codes described in section 7.9 above.

7.11 ERROR CODES

Error codes are shown on the various printouts as **ERR** and a 3 digit code are decoded as follows :

1st Character = OS STATUS

Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
OS bad	**0**	**1**	**2**	**1+2**	**3**	**3+1**	**3+2**	**3+2+1**	**4**	**4+1**	**4+2**	**1+2+4**	**3+4**	**3+4+1**	**3+4+2**	**ALL 4**

2nd Character = A or C detector Error

Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Det A	**0**	**A1**	**A2**	**A1+A2**		**A1**	**A2**	**A1+A2**		**A1**	**A2**	**A1+A2**			**A1**	**A2**	**A1+A2**
Det C	**0**				**C1**	**C1**	**C1**		**C1**	**C2**	**C2**	**C2**	**C2**	**C1+C2**	**C1+C2**	**C1+C2**	**C1+C2**

3rd Character = B or D detector Error

Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Det B	**0**	**B1**	**B2**	**B1+B2**		**B1**	**B2**	**B1+B2**		**B1**	**B2**	**B1+B2**		**B1**	**B2**	**B1+B2**
Det D	**0**				**D1**	**D1**	**D1**	**D1**	**D2**	**D2**	**D2**	**D1**	**D1**	**D1+D2**	**D1+D2**	**D1+D2**

As an example, **ERR=004** means **OS** are OK, Detector **A & C** are OK but **D1** is defective.

7.12 DEFAULT PARAMETERS

The GR-526C has a selected optimised set of parameters in memory. When the Software is loaded these DEFAULT PARAMETERS are automatically loaded and unless changed by the user they are the parameters that the system uses for analysis. The set of DEFAULT PARAMETERS listed below have been carefully selected by Exploranium to optimise system performance in a TYPICAL INSTALLATION.

The GR-526C has many parameter option but users are advised **THAT ANY PARAMETERS OTHER THAN THE DEFAULT PARAMETERS THAT ARE SELECTED BY THE USER - MAY SERIOUSLY LIMIT SYSTEM PERFORMANCE. FOR THIS REASON USERS ARE STRONGLY ADVISED TO DISCUSS ANY SYSTEM "PROBLEMS" (THAT MAY BE RESOLVED BY PARAMETER CHANGE) WITH EXPLORANIUM BEFORE THEY ARE CHANGED TO PREVENT POTENTIAL SYSTEM PERFORMANCE PROBLEMS.**

A full description of each Parameter can be found in Section 8.

Sample Period = 20
Average Time = 4
Settling Time = 20
Number parameter = 7

Analog scale = 10000
Number Detectors = 4
Number Opt. Sens. = 2
Alarm Mode = 0

LOW Alarm L1 = 60 (L1C = 60, L1D=60)
LOW Alarm L2 = 6

Correction = 0
Modem = YES
Print Alarms = YES

Disc = 10
C mode = C

Date/Time = as required
US Format = YES

Bk HIST (1/0) = DAILY
ALARM DETAILS : YES

PASSWORD = 1234

7.13 MODEM SUPPORT

Users are strongly recommended to connect a DEDICATED telephone line to the GR-526C system. This permits the Exploranium Service Department to access the system to aid users in system problem analysis. Many users get "strange" alarms from time to time (see Appendix A for examples). It is often a great help to request Exploranium to access the system and "view" these "strange" alarms so as to give an opinion on correct interpretation.

Another major use of the telephone access is that the GR-526C has the capability of AUTOMATICALLY calling the Exploranium Service computer in case it diagnoses an internal system problem. In this case Exploranium can often contact the system, analyze the problem and advise the user - often before they are aware a problem exists (at least in a semi-unattended location).

Exploranium also offers users Service contracts (TELE-CHECK) that require Exploranium to test the system weekly via the telephone line, to check system operation (and provide written reports). This callup procedure is extremely difficult (and thus expensive) if the local user must be contacted to move the phone line each time, besides the problems of users not plugging the phone cable in, or incoming phone calls on the same line interfering with system operation! For these reasons this support feature is NOT available unless a dedicated line is installed.

7.14 AUTO ERROR REPORT

If requested by the user, any GR-526C that has a DEDICATED telephone line connected, can be enabled to automatically call the Exploranium Service Department computer system in the event of system malfunctions.

This feature can only be enabled from Exploranium by Modem access. The user must define the appropriate telephone dial codes for the installed GR-526C system to contact the factory.

When this feature is enabled, if an error is detected in the system, the GR-526C console will wait **1 HOUR** to confirm the problem then dial the embedded telephone number. If this call gets a BUSY signal the call is repeated every hour until the error message is transmitted successfully. When this Error Report is received by the factory computer, the DATE-TIME-Serial #-and Error Code is displayed and the Service Department will then call the system and follow up on this problem. After investigation the Service Department will then contact the customer to advise them of system status.

7.15 DATA OUTPUT

A special RS-232 Serial Data port in the console is used to permit recording on an external PC of ALL the data from OS and all individual detectors using a special program on the external PC.

This capability permits the development of custom software for special applications and also permits ARCHIVING of data if required.

Exploranium has developed support software to run on an external PC for those users who require that the radiation levels of ALL buckets be recorded for archive purposes. Please contact Exploranium if you require this type of software support. If an existing application program can be readily adapted to your application this can often be done on a NO CHARGE BASIS. However if extensive software development is required for special applications, Exploranium can provide a fixed-price quote on such a project.

7.16 DUMP ALARM & HISTORY FILES

Some users have requested the ability to easily dump the ENTIRE History and Alarm files. This is an unusual requirement but since this is a necessary feature if new software is installed (see below) this feature has been implemented by Password access.

If the Password **< 4 - 6 - 9 - 7 - ENTER >** is entered into the system, the entire History and Alarm files are printed on the printer. During this printout the display shows :

Printing HISTORY file
Please wait ...

and

Printing ALARM file
Please wait ...

If these files are extensive this can take some time (typically 30 secs/Alarm and 2 minutes for a complete History File) so in a typical situation a complete dump takes about 5 minutes. Since during this time SYSTEM MONITORING IS DISABLED, users should ensure that they choose an appropriate "quiet" time on the scale. During the total printout, the YELLOW traffic light is ON to stop buckets entering the detectors to prevent any buckets missing analysis.

7.17 CHANGING SOFTWARE

WHEN NEW SOFTWARE IS LOADED THE HISTORY AND ALARM FILES ARE AUTOMATICALLY ERASED! USERS SHOULD CAREFULLY FOLLOW INSTALLATION INSTRUCTIONS ACCOMPANYING THE SOFTWARE UPDATE WHICH PERMITS A PERMANENT RECORD OF CURRENT DATA.

If these procedures are followed a complete printout of the current ALARM and HISTORY files is made as a permanent record of the system up to that point.

8.0 SYSTEM PARAMETERS - DETAILED

System Parameters are set during installation, and under normal operating conditions do not require adjustments. **Modification to these parameters may result in seriously degrading system performance.** To restrict access to the system parameters, they are Password protected. The system parameters Password is set at installation, and is provided to the user at that time. The password can be changed at any time by entering the system parameters menu. **(1234 is used as an example of a system parameters password below) :**

8.1 FIRST PARAMETER SCREEN

To enter the system menu, press **<ENTER - 1 - 2 - 3 - 4 - ENTER>** and the following display appears : Enter the required value using the keyboard and press **<ENTER>** to continue to the next line. Continue this sequence until all parameters are set.

Sample Period	**20**
Average Time	**4**
Settling Time	**20**
Number Parameter	**7**
Analog Scale	**10000**
Number of Detectors	**4**
Number of OS units	**2**
Alarm Mode	**0**
Alarm Level 1	**60**
Alarm Level 2	**6**
Correction	**0**
Modem	**YES**
Print alarms	**YES**

NOTE : ANY DIFFERENCES IN PARAMETER SETTINGS BETWEEN OPERATIONAL MODES IS DETAILED BELOW.

8.2 SAMPLE PERIOD - (DEFAULT=20)

This is the time period selected to suit local logistics and is related to Bucket size and speed of movement.

8.3 AVERAGE TIME - (DEFAULT=4)

This parameter sets the correct averaging time used by the system. In most installations the magnet causes some level of data interference. This is heavily

protected in the GR-526C but to ensure correct performance the averaging time used must be carefully selected. Experience has indicated that a 4 minute period is a good compromise. Note that this is not a DELAY PERIOD - it is simply a mathematic control used to limit background/magnet data fluctuations.

8.4 SETTLING TIME - (DEFAULT = 20)

In the MONITOR-WHILE-LOADING mode of operation - some time is taken from the time that the OS are activated by the bucket entry to the time that the bucket is actually at rest and real analysis can take place. This period varies considerably with local logistics and bucket size but normally 20 seconds is a good selection.

If this time is TOO SHORT - then incorrect system operation will occur as the computed values for analysis are only correct if the bucket is at rest.

If this time is TOO LONG then it may interfere with operational logistics.

8.5 NUMBER PARAMETER - (DEFAULT=7)

Special parameter to limit interfering alarms and prevent False Alarms - must be set to 7 under normal conditions.

8.6 ANALOG SCALE - (DEFAULT=10000)

This parameter sets the maximum vertical scale of the front panel "chart-recorder" display. May be set at 5000, 1000, 20000, 50000 or 100000 counts/second FULL SCALE. If this scale is set incorrectly the system will still function correctly but the "chart-recorder" may be difficult to view.

8.7 NUMBER DETECTORS - (DEFAULT=4)

This parameter sets the system to match the supplied detectors. The GR-526C can

support from 1 to 8 detector sets in multiple combinations for special applications. Normally this is set to 4 for a 2 detector Bucket monitoring system.

OTHER DETECTOR CODES

The "**No. of Detectors**" parameter can be set from 1-24 with the following result:

1	A1+A2
2	A2+B2
3	A2
4	A1+A2+B1+B2
5	A1+A2+B2
6	A1+A2+B1+B2+C1+C2
7	A2+B2+C2
8	A1+A2+B1+B2+C1+C2+D1+D2
9	A1+A2+B1+B2+C2
10	A2+B2+C2+D2
11	A1+A2+B1+B2+C2+D2
12	A1+A2+B1+B2+C1+C2+D2
13	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2
14	A1+A2+B1+B2+C1+C2+D2+E2+F2
15	A1+A2+B1+B2+C1+C2+D1+D2+E2
16	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2
17	A1+A2+B1+B2+C1+C2+D2+E1+E2+F2
18	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2+G1+G2
19	A1+A2+B1+B2+C1+C2+D1+D2+E2+F2+G2
20	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2+G1+G2+H1+H2
21	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2+G2
22	A1+A2+B1+B2+C1+C2+D1+D2+E2+F2+G2+H2
23	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2+G2+H2
24	A1+A2+B1+B2+C1+C2+D1+D2+E1+E2+F1+F2+G1+G2+H2

8.8 NUMBER OPT. SENSORS - (DEFAULT=2)

This parameter sets the number of OS units in the system. There are 2 selections:

1 = this is a special selection that sets the system to operate in 1 direction only for incoming FULL buckets - **OS1>OS2**. This is primarily a special selection for Monitor-while-Full. Do NOT use this selection unless advised to by Exploranium.

2 = This sets the system for 2 OS units and is the correct selection. In Monitor-while-Full this permits bi-directional operation.

8.9 ALARM MODE - (DEFAULT=0)

This mode selects the method of data analysis which is dependent on bucket method of operation. selections are :

- **0 - Monitor-while-loading**
- 1 - Monitor-while-Full with 1 bucket size
- 2 - Monitor-while-Full with 2 bucket sizes
- 3 - Monitor-while-Full with 3 bucket sizes
- 4 - Monitor-while-Full with 4 bucket sizes
- 5 - Monitor-while-Full with 5 bucket sizes
- 6 - Monitor-while-Full with 6 bucket sizes
- 7 - Monitor-while-Loading for Detector A+B and Area Monitor for detector C

8.10 ALARM LEVEL 1 - (DEFAULT = 6)

This alarm parameter is primarily for alarm detection AFTER THE SOURCE IS IN THE BUCKET.

This parameter sets the alarm level threshold analysis level and is a balance between sensitivity and false alarms and is highly dependent on local logistics, bucket size, crane speed of loading, magnet size, magnet maintenance etc. Experience indicates that a level of **11** is suitable for most applications but this will be tested on site and adjusted as required during system startup to ensure the optimum level of sensitivity.

Note that the parameter is set in STANDARD DEVIATIONS (SDS) and is related to the

COUNTS/SECOND data

8.11 ALARM LEVEL 2 - (DEFAULT=60)

This alarm parameter is primarily for alarm detection WHILE THE SOURCE IS ON THE MAGNET/GRAPPLE.

Parameter selection has similar constraints to Level 1 selection - typically a value of **60** suits most applications but this parameter will be optimised during system startup.

Note that this parameter is set in 0.1 SD units but is related to 0.1 sec data samples.

NOTE : If MODE = 1-6 then Alarm level 2 is replaced by :

BG PARAMETER (DEFAULT=99) -used to limit local background changes - set by Bucket Depression

8.12 DANGER ALARM - PRESET=300000

This Alarm Level is triggered **WHEN ALL SELECTED DETECTORS ARE ABOVE LEVEL H4**. Thus a **DANGER ALARM** indicates that there is **PROBABLY** a HIGHLY RADIOACTIVE source in the bucket and this alarm should be treated with GREAT CAUTION and personnel exposure limited.

A special display and printout is used to emphasize the potential hazard of this alarm level (see Section B3.4 and B3.6).

Note this parameter is set in COUNT/SEC units.

8.13 CORRECTION - (DEFAULT=0)

Special parameter used to optimise system performance. Normally the detectors are analysed separately, however under certain logistic conditions alarm analysis

related between detectors is sometimes an advantage. Selections are :

0 = Independent analysis of A and B detectors
1 = Related analysis of A and B detectors

8.14 MODEM - (DEFAULT=YES)

If the system is to be connected to a telephone line to permit remote access (highly recommended), set to **YES**. If the user cannot supply even limited access to a line, set to **NO**. Note that if set to NO, then NO access is possible via Modem. See Section 6.16 for more details. Recommended setting = YES.

8.15 PRINT ALARMS - (DEFAULT=YES)

User may select :

YES : Alarms are displayed, stored in memory and printed as they occur.
NO : Alarms are displayed, stored in memory and may be printed later from the alarm memory

Once **ENTER** is pressed to accept this selection a second selection is required :

INT : system uses the INTERNAL system printer
EXT : system uses an EXTERNAL printer. This selection permits data output to an external printer (HP LaserJet compatible) for full page printing. Note that for external printer use the user must :

- disconnect the Internal Printer
- remove the +5V Printer fuse from the console CPU board
- use special PCB to replace the printer
- use standard printer cable to connect to printer

8.16 CONTRAST

At this parameter the display contrast can be changed using the Cursor keys
The next screen, **DISCRIMINATOR SETTINGS**, is as follows:

8.17 DISCRIMINATOR SETTINGS

The

```
Line  |              Discriminator/Mode setting                    |
2     |        16 : 11 : 28 : 08             16 : 11 : 28          |
3     | -------------A-------------------------C----------------- |
4     |        C             C                                OS12 |
5     |    10    10      10    10                                 00 |
6     |      2652          2726                                   39 |
7     |      2659          2710                                      |
      |                                                              |
8     |        C             C                                     |
9     |    10    10      10    10                                  |
10    |      2127          2525                                    |
11    |      2113          2501                                    |
12    |  -------------B-------------------------D--------------- |
13    |  M o d e    1 - A,  2 - B,  3 - C                          |
14    |  Discrim    CLEAR - left, ENTER - right                    |
15    |             UP +,  DOWN -, STOP - END                      |
```

Discriminator Settings screen is described below. (As an aid to the user we have shown a Line Number, but this does not appear on the actual screen). To change any parameters the CURSOR (blinking square) must be positioned at the parameter. As lines 14 and 15 indicate, press **<ENTER>** to move the cursor to the right or press **<CLEAR>** to move it to the left.

Line 2 the two times of day shown here are the INTERNAL clock and the DERIVED clock. These should be the same.

Line 3 and 12 is the detector label - A/B are the ones either side of the bucket (A is normally the closest to the console)

Line 4 and 8 is the mode of operation - should be C. The cursor indicates which detector is being worked on (**<ENTER>** moves you to a new detector). When at the selected detector, line 13 indicates action - press key **<1>** to get A only, key **<2>** for B and key **<2>** for C.

The "A" and "B" mode are for special purposes only.

Line 5 and 9 is the discriminator setting for the A/B phototubes, should be set to 10 for each using the keys indicated in line 14.

Line 6 and 10 is the 1 second reading from that detector in counts/sec.

Line 7 and 11 is the 30 second average from the selected detector. The 30

second average may be restarted by pressing **9** on the keyboard.

Press **<STOP>** to exit this screen.

OTHER PARAMETERS

```
          Date/Time Setting
D a t e :      M M / D D / Y Y
T i m e :      H H : M M : S S

  US Format :              YES
  Bk Hist (1/0)          UNIT
  Alarm details             YES

              PASSWORD
              _________
```

8.18 DATE/TIME

Date/Time Enter the Date and TIME using the numeric keys and press ENTER

USA Format **<1>** = YES = (default) - US Format - MM/DD/YY
<0> = NO - the date is in the DD/MM/YY mode as used in Europe.

8.19 Bk Hist - (DEFAULT = DAILY)

This parameter offers 2 selections :

UNIT - Gives a summary of bucket analysis on a bucket by bucket basis. This selection is used during system setup to assess the effect of local logistics on system performance.

DAILY - Gives a summary of system performance on a DAILY basis - useful for system users who want to ensure that all buckets are analyzed correctly.

8.20 ALARM DETAILS - (DEFAULT = YES)

YES - This adds some of the raw data that caused the alarm to the alarm printout to aid in alarm analysis.

NO - Normal alarm printout without raw data.

8.21 PASSWORD - (DEFAULT = 1234)

Users may select a special system Password (up to 4 digits) to prevent unauthorized users from changing system parameters.

It is highly recommended that users set some non-obvious Password to prevent unauthorized access to system parameters - it must be emphasized that unauthorized adjustment of parameters CAN COMPLETELY DISABLE THE SYSTEM!

SPECIAL NOTE: ALL PARAMETERS WILL BE SET BY AN EXPLORANIUM ENGINEER AT THE TIME OF INSTALLATION. ANY CHANGE TO THESE COULD HAVE SERIOUS CONSEQUENCES ON SYSTEM OPERATION. PLEASE CONTACT EXPLORANIUM BEFORE CHANGING ANY SETTING ON THE GR-526C SYSTEM.

APPENDIX A - "NUISANCE" Alarms

From practical experience, as the acknowledged leader in vehicle monitoring technology with an installed base of more than 500 units, over the last 8 years a large variety of practical problems have been experienced. The GR-526 systems have been extensively modified over the years to "solve" most of these problems but it is impossible to prevent certain spurious alarms. These alarms are not **FALSE ALARMS** because they are REAL alarms as far as the system is concerned, however to the user they are NOT the big shielded source that is the REAL danger. However in most cases they have the same characteristics as a REAL alarm, so for this reason they are defined as NUISANCE alarms. Any monitoring system with enough sensitivity to detect deeply buried shielded sources will suffer from these NUISANCE alarms, as there is no technological way to prevent them occurring (however sophisticated data processing in the GR-526 limits many of these effects) - because such a system sees the REAL and NUISANCE alarms as the same. Thus any serious attempt to prevent these NUISANCE alarms will impair the systems ability to detect REAL alarms, so they must be lived with. As a guide to users the following types of NUISANCE alarms are common :

(a) CONTAMINATED PIPE

Contaminated Pipe - is usually steel pipe that has been used in the Oil or Potash industries and has a "scale" on the inside of the pipe that contains radioactive material - usually Radium or Thorium. This scale is usually of a low enough radiation level to be safe to handle, and if melted in the furnace would "disappear" WITH NO MEASURABLE EFFECT ON THE ENVIRONMENT or STEEL PLANT. Unfortunately this pipe typically has a RADIOACTIVE SIGNATURE that is often identical to a REAL shielded source. The MAJORITY of material detected by the GR-526 will usually be this pipe material BUT IF THIS IS NOT DETECTABLE, NEITHER IS A REAL SOURCE.

(b) "MEDICAL" ALARMS

Some plant personnel may receive special medical treatment involving radioactive tracers (Barium enema etc). For the next few days after this treatment they act as a radiation "source" to the GR-526 system. Even though such radiation is low level it can often be enough to set the alarms off. This particular type of alarm is very aggravating as it is so variable. For example if such a human "source" passed near the detectors WHEN A BUCKET IS LOADING, the system user would assume that

the bucket load caused the alarm.

If the Bucket is retested and NO alarm occurs the user could assume that a FALSE ALARM had been generated.

These "medical" alarms can only be isolated by common sense procedures such as restricting personnel near the system during retesting etc.

(c) X-Ray GAUGING SERVICES

In the last few years we have seen many alarms caused by an X-ray crew who are crack testing steel and concrete pipes. This is a common service and involves shooting a high intensity narrow beam of radiation FOR A VERY SHORT PERIOD at the material and illuminating an X-ray plate looking for cracks.

Unfortunately if such a beam is bore-sighted at one of the GR-526 radiation detectors - even though such a source may be more than **ONE MILE** away the GR-526 CAN ALARM.

Normally such alarms are easy to identify as they are quite narrow (typically 1 second) and will of course NOT re-occur when the bucket is re-tested (unless by an incredible coincidence). This problem is often solved by arranging with local X-ray service groups, that they will notify GR-526 users when they are in the vicinity!

(e) MISCELLANEOUS MATERIAL ALARMS

FIREBRICK used to line furnaces has a significant Thorium content and a bucket loaded with some firebrick will usually cause the system to alarm.

CALUMITE is a powder material made by grinding slag etc. This material contains trace amounts of Uranium, Potassium and Thorium and if a large volume is loaded into a bucket it may alarm the system.

OTHER MATERIALS - that can cause alarms:
- Alum (Aluminum sulfide)
- Bonding Mortar
- Bonding pour tile
- Ceramics

- Corrosive solids
- Fiberboards
- Fire brick
- Fire clay
- Fluidox 141
- Industrial ceramics (such as nozzles and sleeves)
- Insulation
- Ladle brick
- Oxytherm R1
- Potassium Permanganate
- Pyro block
- Refractories
- Liquid Petroleum Gas (often contains Radon)

NOTE - some of these materials can contain naturally occurring radioactive material but in volume may create enough of a "radioactive source" to cause a sensitive system to alarm.

APPENDIX D - SPECIAL SYSTEM PASSWORDS

The system has a variety of reserved Passwords as listed below. If the user selects one of these as their Maintenance password, the system will not accept the data and a different Password must be selected.

1492 to access stored ALARM DATA - see Section 4

1590 reserved

3214 to select special TEST mode - see Section 6.17 and Appendix N

4697 to printout the COMPLETE History File and Alarm File - see Section 6.15

5555 to print CURRENT ALARMS - see Section 6.5

7171 controls data output format - see Section 6.14

8741 to temporarily suspend the Speed Alert AUDIO - see Section 6.1 (label = SpSPD)

9191 to access the HISTORY FILE - see Section 6.3

9999 to print CURRENT PARAMETERS - see Section 6.6

APPENDIX F - SYSTEM RESETS

The GR-526 has many special codes for internal fault analysis. These RESET codes are an aid in fault diagnosis and appear on some printouts. The following is a complete list of current RESETS. All codes will be **RESxx** where **xx** is as listed below:

00 Reset if power off in ACI board ---------- PwOFF
01 Restart after setting Parameter Screen
02 Restart after setting Discriminator Screen
03 Restart after setting Date/Time Screen
04 Restart after viewing Alarm File
05 Restart after viewing History File
06 Restart after Remote access by Modem
07 Restart after Dumping History/Alarm File
08 Restart after Sensitivity Test

21 Reset during setting Parameter screen ------- |
22 Reset during setting Discriminator screen ---- |
23 Reset during setting Date/Time screen ------- |
24 Reset during view Alarm file ---------- | all PwDOG
25 Reset during view History file ---------- |
26 Reset during Remote access by modem ----- |
27 Reset after Dumping Alarm/History file ---- |
28 Reset during Sensitivity Test (test interrupted)

34 Reset during Alarm display ---------- PwDOG
36 Reset Power ON ---------- PwOFF
37 Reset after Auto Error report ---------- PwDOG
38 Other RESETs ---------- PwOFF

PwOFF - Power OFF event - this normally indicates that the power to the unit was switched OFF.

PwDOG - A special series of RESETs actions caused by special protection circuitry to prevent the system being kept in a non-monitoring mode for an excessive period of time.

APPENDIX K - RECOMMENDED MAINTENANCE PROCEDURES

c) **SET UP A SYSTEM LOG BOOK** for each system and mark Serial # then specify that the Scale Operator record (at a MINIMUM) the following data for EACH alarm and any system errors :

Date	Time	Alarm#	Alarm level	User actions	Signed
5/9	11:05	21	1A	Ran truck through again	
5/9	11:08	22	1A	Ran truck through again	
5/9	11:11	23	1A	3 alarms confirmed - Notified Mr. ..... that truck rejected	
5/11	13:25	25	1b	Test Alarm - Maintenance	
5/12	14:22	Error		OS error, notified Maintenance	
etc					

Such a log permits :

- the Radiation Safety Officer (RSO) to have a record of all actions taken. Using a regular full Alarm printout (see below) they can ensure that ALL alarms were handled correctly - and investigate errors
- show that the user is responding correctly to system errors and notifying Maintenance as required
- show that someone (Maintenance?) Is carrying out regular Test alarms to ensure that the system is functioning correctly

2. SET UP A MAINTENANCE LOG BOOK for each system - mark each with the appropriate SERIAL #.

Enter in the LOG BOOK - the date of installation and after the installation is OK, printout Current Parameters (STANDARD) - see Manual Section 4.12 - and glue/tape into the book

It is highly recommended that as the various tests are carried out on the system, that sequential (dated) notes are kept in the logbook. Also regular Test Alarms -

Parameter + History printouts etc. should be glued into this logbook thus providing an invaluable record of system performance and a reference guide to track persistent problems.

3. DAILY SYSTEM CHECK - MINIMUM actions by USER

1	Inspect the display and ensure that the Yellow STATUS button is NOT flashing. If it IS flashing note the Errors on the display and call Maintenance
2	Inspect the display and ensure that Date and Time are correct - if Date/Time have changed significantly - notify Maintenance

4. WEEKLY SYSTEM CHECK - MINIMUM actions by MAINTENANCE

1	Check OS alignment - ensure that all OS Receivers have a “fast pulsing” light (2 flashes/sec - slower is bad) - mark in log as a record
2	Check that Date/Time are set correctly - a significant change could indicate that DEFAULT parameters have been loaded due to RAM error
3	Print out Current Parameters and compare to normal parameters printed in the LOG BOOK - glue in log as a record
4	Carry out a SENSITIVITY CHECK - as per Appendix N. Inspect and glue in logbook as a record

APPENDIX N - SYSTEM TESTING

GENERAL - Many users want to test their GR-526 systems on a regular basis. Exploranium strongly recommends this practice as a means of ensuring system performance is being maintained correctly. The following procedures are recommended for correct performance monitoring.

The basic testing method involves placing a Test Source on the face of the detector and then noting the change in count rate on the console. The system provides a data printout of the results that can be used to check system performance on a regular basis.

SYSTEM TESTING - (Minimum MONTHLY - recommend Daily or Weekly)
In this procedure a special test source is used in a fixed location on each detector. A 30 second reading is taken for each detector with and without the test source. This process is semi-automatic and requires only 1 person to carry out the test. At the conclusion of these tests the SOURCE data is corrected for background and the system printer is used to provide a hard copy. This test procedure should take only 2-3 minutes for a 2 detector system and provide very repeatable data for system performance analysis.

SPECIAL SOURCE MOUNTS
After various requests from users for a SIMPLE, REPEATABLE test, Exploranium has constructed a special “source holder” that must be glued in place at the required place on the detector face. These holders are made of steel and the supplied special Test Source has magnets in it so it will stay in place in the source holder. The reason for this holder is that for repeatable results, at least a 30 second sample must be made at each source location and it is extremely difficult to hold the source at a fixed location manually for this period of time.

New GR-526 (510) units are supplied with these source holders installed but older systems can be upgraded using the **SOURCE-HOLDER KIT** (PN 93610) available as an optional item from Exploranium and this kit usually includes: 2 source holders (1/ detector), 1 - magnet equipped Test Source. (Note that the Exploranium Service department should be consulted regarding upgrades to ensure the correct items are supplied)

NOTE : IF THIS TEST IS CARRIED OUT WITHOUT USING THE SOURCE HOLDERS FOR PRECISE POSITIONING - THE TEST WILL WORK CORRECTLY BUT THE DATA MAY NOT BE REPEATABLE FROM TEST TO TEST DUE TO CHANGES IN THE SOURCE POSITION.

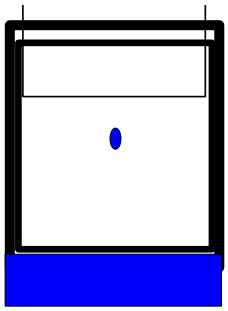
SOURCE

To get repeatable data it is very important that the SAME source be used for each test and that the source is placed the SAME way up every time. (The test source has a slightly different performance if placed face-up or face-down on the detector). Note the “magnet-equipped” Test Source is colour marked to ensure it is not confused with the “normal” Test Source.

SOURCE POSITION

It is important that the test source be positioned on the detector at the same place each time. If the source position is very repeatable then the test data results can also be used to assess system performance over the long term.

The optimum Test Source location is shown at point **Y** in Fig. 22.



Each detector box actually has 2 detectors inside it and for best results the external source should be positioned to give approximately the same response from each detector. The GEOMETRIC centre of the detectors is usually the correct location but in some cases due to internal mechanical variations in the detector, this centre position is a poor choice. The recommended method is to temporarily attach the source mount and carry out the following Test Procedures, then inspect the results to determine if the selected location is OK. The best performance is if the Test Source signal (**SIG** in Fig. 11) is approximately equal on the 2 detectors in each box (+/- typically 10%). This is easily checked by repeating the procedure for various source holder locations, until the best location is determined. Once the correct location is found the source ring should be glued in place.

2.5 TEST PROCEDURE

5. Ensure that no buckets will pass through the system in the 4-5 minutes normally required to test the system as this procedure disables system monitoring.

b. Ensure that there are no buckets parked in front of the detectors and preferably none within 30 ft (10m). These test results are often used for comparative system analysis and so it is important not to distort the data by passing buckets influencing local background results.

c. Enter Password **3214** (best method is **<Enter 3 2 1 4 Enter>** - slowly) :
NOTE : a 3 minute timer is started once this Password is entered, if 3 minutes pass **with no user action** this test procedure will automatically terminate to ensure that the system cannot be left in the test state.

ACTION : System is ready to start the Test
DISPLAY **SENSITIVITY TEST** (at the top)
RUN = start STOP=exit
TRAFFIC LIGHT : RED = **ON** - all others OFF

d. The user should ensure no buckets are nearby and no one is walking between the detectors - then press **RUN**
ACTION : 30 second background average is being computed
DISPLAY **Background meas**
xx (xx starts at 30 secs and counts down)
TRAFFIC LIGHT : RED = **FLASH** - all others OFF

e. At the end of this time the audio will “beep” 3 times and :
ACTION : System has stored background and is ready for source tests.
DISPLAY **SENSITIVITY TEST** (at the top)
RUN = start STOP=exit
TRAFFIC LIGHT : RED = **ON** - all others OFF

f. Locate the magnet test source - and press **RUN** :
ACTION : System is waiting for a test source - user has 3 minutes to place the source on any detector
DISPLAY **SENSITIVITY TEST** (at the top)
A B (also C,D etc. if installed)

TRAFFIC LIGHT : RED = **ON** - all others OFF

g. The user must now take the special magnetic Test Source and place it on ANY detector in it's special holder, **then stand back clear of the detectors.** The program can recognize which detector has the source in place and as soon as this identification is complete, the test of that detector begins.

As an example place it on the **B** detector first :
ACTION : **B** detector data is being analysed.
DISPLAY **Source B**
xx (xx = 30 secs and counting down)
TRAFFIC LIGHT : RED = **FLASH** - all others OFF

h. When the Traffic Light goes from **FLASHING** to **STEADY**, move the source to the next detector.

If NO Traffic Lights are installed - use a watch and wait 45 seconds after the source is firmly in place before retrieving it and moving it to the next detector.

NOTE : If somehow the source is removed by accident before the 30 second accumulation is complete, just place it back in place and the test will be restarted on that detector.

If you moved it to the **A** detector :
ACTION : **A** detector data is being analysed.
DISPLAY **Source A**
xx (xx = 30 secs and counting down)
TRAFFIC LIGHT : RED = **FLASH** - all others OFF

i. When all detectors have been tested the Traffic light will change briefly to RED.

Remove the source and return to the console.

NOTE : As each detector test is complete, it's label will be erased from the console display screen. If somehow the user did not test a detector - it will still be displayed on the screen and it can be immediately retested.

j. The system printer should produce a printout in a few seconds, then the Test is complete. During this time :
TRAFFIC LIGHT : YELLOW = **ON** all others OFF

k. When all is complete (a few seconds) **:**
TRAFFIC LIGHT : GREEN = **ON** all others OFF

l.The test printout appears as shown in Fig. 23.
Users should use the SIG data only as this is the data from the SOURCE after BACKGROUND has been removed (SIG=Src-BACKGROUND).

The **SIG** data should be accurate typically better than +/-10% or better from test-to-test, but this depends on local conditions. When this testing system is first implemented Exploranium suggest that it be repeated 4 times in 1 week and the data discussed with Exploranium to select a reasonable estimate of probable repeatability.

```
_____________________________
SENSITIVITY TEST      # 9999
 3/26/97              12:09:13
-------------------------------------------
 Detector      BG     6122
    A          Src   23848
               A1/A2   96
               SIG    17726

 Detector      BG     5352
    B          Src   18199
               B1/B2     97
               SIG    12847
-------------------------------------------
```

THE SYSTEM IS NOW READY FOR NORMAL OPERATION.

NOTES :

a. Discuss the data with the Service Department if any strange effects are noted.

b. Careful recording of these data on a regular basis will provide a reasonable estimate of system long term performance. Some ageing of the system with time will probably be seen but this should typically be less than 5-10%/year. Data changes significantly greater than this would suggest premature failure of some components - please discuss with the Service department if this occurs.

APPENDIX Z - SYSTEM SOFTWARE CHANGES

Z.1 Changes in 8V46 & 8V47

GR-526 USERS MANUAL - **INDEX**