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Timing and Control Monitor
System Upgrade
Design Document

Designed by
The Timing and Control Monitor
System Upgrade
Project Team

Written by
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Version 4

MASTER

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11.0 REQUESTED CAPABILITIES WHICH WILL NOT BE IMPLEMENTED

APPENDIX A - Glossary of Terms

APPENDIX B - The Project Team

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1.0 SCOPE

This document describes the capabilities which will be implemented in the T&C Monitor System. It should be used by the user community as a tool for anticipating how the new Monitor System will be used. If there are questions about the proposed system capabilities, you are encouraged to contact any project team member. It will be used by the development team as a design tool.

This document will be used as a reference and a guideline throughout the project whenever there is a question about proposed system capabilities.

1.1 Identification

This is a design document for the Timing and Control Monitor System Upgrade Project. This project is intended to provide a replacement system for the existing User Encoder Monitor Systems and Varian 72 Control Room computer systems. All of these systems reside at the Nevada Test Site.

1.2 Functional Summary

The function of the T&C Monitor System is to gather real-time statistics and data on user defined key variables from control, communication, data acquisition systems, and from the monitoring system itself. The control, communication, and data acquisition systems each operate separately from the monitor system.

The T&C Monitor System gathers this data in order to:

- verify the readiness of an event to begin countdown. This includes setup, verification, calibration, and peripheral services.
- report any failures that may occur during the countdown
- verify detonation and containment
- assist reentry activities after the event

The new monitor system is functionally very similar to the current monitor system. Two VAX 11/750 computers will replace the two Varian computers and LSI-11/23's will replace the current

User/Encoders. The VAX computers will reside at CP-9 and receive monitor information from the LSI-11/23 systems which will reside in user trailers in the forward area. A list of the features for the new system can be found in the Objectives section under Functional Design.

The LSI-11/23 systems will be called Timing and Control Operations Monitors, TCOM's.

1.3 Basic Assumptions

With any system there are certain basic assumptions which must be made. In fact, in some cases these are not assumptions, they are facts. The following are assumptions about the T&C Upgrade Project.

It is assumed that:

- The reader of this document is somewhat familiar with the T&C System and the NTS Nuclear Test Program in general.
- The Forward Area and the CP will be able to communicate via a microwave link.
- The T&C Monitor System will collect, display, and store only monitor data.
- The T&C Monitor System will not collect any diagnostic data.
- There are no nuclear safety issues pertaining to the T&C Monitor System itself.
- The T&C Monitor System will not collect, save, or display any classified data.
- The reader understands the glossary of terms in the appendix.

1.4 Document Structure

This document is structured identically to the Timing and Control Monitor System Requirements document, UCID 19642, so that requirements can be traced through to design. This will assist users in identifying requirements which will not be implemented. In additions, Section 11 lists all known requirements which will

not be implemented in the new Monitor System.

1.5 Design Verification

This design document was verified for completeness and accuracy by using the following documents:

1. T&C Monitor System, Structured Specification, The New Logical Model, June 6, 1983, J.J. Brandt, R.P. Ritenour
2. Timing and Control Monitor System Requirements, UCID 19642, November 16, 1982, Winslow Brough, Joe Brandt, Bob Browning, Bill Hensiek, Bob Ritenour.
3. T&C Monitor System Upgrade Performance Specifications for Concurrent Activities, T&C Monitor System Upgrade Project, Winslow G. Brough, September 7, 1983.
4. Timing and Control Monitor System Upgrade Project; installation, Checkout, and Operational Requirements, Mac Baker, Joe Brandt, Bob Browning, Bob Ferguson, Bill Hensiek, J.J. Kempf, Carl McCormick, September 27, 1983.
5. Questions to be Answered for the Timing and Control Monitor System, Joe Brandt, Bill Hensiek, July 27, 1983.
6. All meeting and interview notes up to the current date of this document.

2.0 APPLICABLE DOCUMENTS

1. T&C Monitor System Upgrade Physical Requirements, November 16, 1981, D.W. Baltz, R.A. Browning, F.W. Hensiek.
2. T&C Monitor Upgrade User Interface Requirements, January 19, 1982, W.G. Brough
3. T&C Monitor System Reliability Issues, March 22, 1982, W.G. Brough
4. T&C Monitor System, Structured Analysis, Current Physical Model, D.W. Baltz, R.A. Browning, F.W. Hensiek, Ted Stratford
5. T&C Monitor System, Structured Specification, The New Logical Model, June 6, 1983, J.J. Brandt, R.P. Ritenour
6. T&C Monitor System Upgrade Project Notebook
7. Timing and Control Monitor System Requirements, UCID 19642, November 16, 1982, Winslow Brough, Joe Brandt, Bob Browning, Bill Hensiek, Bob Ritenour.
8. T&C Monitor System Upgrade Management Plan, March 1983, W.G. Brough, UCID 19781
9. T&C Monitor System Upgrade Project Plan, Winslow G. Brough, Project Engineer, February 23, 1983
10. T&C Monitor System Upgrade Performance Specifications for Concurrent Activities, T&C Monitor System Upgrade Project, Winslow G. Brough, September 7, 1983.
11. T&C Monitor System Upgrade Project, Structured Design Document, J.J. Brandt, A.V. Hansen, Ed Hwang, R.P. Ritenour, Ted Stratford, J.J. Woo, October, 1983

3.0 FUNCTIONAL DESIGN

3.1 Objectives

1. To increase the analog and digital monitoring capability per user.
2. To provide installation, verification, and checkout of the Monitor Systems in the trailers independent of the communications and CP computer systems.
3. To automate the event requirements input process for the T&C Monitor System.
4. To automate Script generation.
5. To provide real-time monitor information in the trailers during installation, verification, calibration, checkout, and dry runs.
6. To provide backup storage of monitor information in the trailers. This also allows for independent monitoring.
7. To provide for real-time archival of all monitor information.
8. To provide more advanced data conversion capabilities.
9. To provide more comprehensive audio and visual alarm capabilities in the Forward Area and the Control Room.
10. To provide more comprehensive compositing capabilities.
11. To provide more display capabilities in the Control Room.
12. To provide more flexibility in the display layouts.
13. To provide for the retrieval of all monitor information in the form of graphical and textual reports.
14. To provide a monitor system which is reliable such that no pertinent monitor data is lost.

3.2 Inputs

Input to the Monitor System will be in the form of parameters, usually called T&C requirements, and actual monitor information. LSI-11/23 systems will be used to obtain both the parameters and the actual monitor information. TCOMs will be capable of operating in stand alone mode or as an integral part of the new Monitor System by communicating with the CP systems via the microwave link.

The entered parameters must be transferred to the VAX at CP either physically via a floppy disk or they can be transferred by using the microwave link.

3.2.1 Analog Data -

Each TCOM will have 64 analog channels with the capability of expanding to 128 channels.

See the section called 'threshold checking for analog data' under Processes for an explanation as to how analog data channels will be monitored.

3.2.2 Digital Data -

Each TCOM will have 130 channels of digital input capability with the capability of expanding to 196 channels. Two of the 130 channels will have the capability of interrupting the LSI-11/23 when that digital channel changes state.

The digital channels will be used to monitor the normal digital monitors. In addition, the digital input channels will be used to monitor automatic and manual commands from the T&C Command System. The automatic commands will be monitored with one of the interrupting digital input channels. Each manual command will be monitored by a unique digital input channel. Notice that the user will have access to one of the interrupting digital input channels and all of the other digital channels which are not being used to monitor a manual command.

3.2.3 Set-up And Operating Parameters -

Users will be able to input set-up parameters using the TCOM. This means that the parameters can be input wherever the TCOM resides which could be at Atlas or the Forward Area. In fact, parameters could be input anywhere there is an LSI-11/23, provided the user has a copy of the TCOM software, which will be provided on floppy disks. All parameter input can be done independently, without the communications link and the CP computer systems.

Each user will be responsible for the input, verification, checkout, and modification of their own input parameters. T&C personnel will check the validity of user parameters; however, the users will be responsible for any modifications if inconsistencies are found by T&C personnel.

3.2.3.1 User Input Parameters -

Notice that for some user parameters there will be default values for each user and that those values will not have to be entered for each event. This will speed up the parameter input process.

Notice that not all parameters are required, those not required will be surrounded by parens (). There are also parameters which require several sets of input, for example the parameters for the digital and analog channels, those parameters will be surrounded by braces {}.

```
event name
user name
number of trailers
  {trailer name}
    number of analog channels
      {channel label}
      {conversion value}
      {channel units}
      {(lower alarm limit)}
      {(beginning time and ending time for limit)}
      {(upper alarm limit)}
      {(beginning time and ending time for limit)}
      {(lower warning limit)}
      {(beginning time and ending time for warning)}
      {(upper warning limit)}
      {(beginning time and ending time for warning)}
      {data threshold value}
      {time threshold value}
      {(critical monitor, T&C personnel only)}
```

```
{plus time value when monitoring can stop for
this channel}
    A default value will be used if no value
    is specified. Users will be able to also
    specify that the channel be monitored until
    the event is released.
    {(comment)}
number of digital channels
    {channel label}
    {digital state}
    {beginning time for this state}
    {(up to speed time for this state)}
    {(critical monitor)}
    {plus time value when monitoring can stop for
    this channel}
        A default value will be used if no value
        is specified. Users will be able to also
        specify that the channel be monitored until
        the event is released.
        {(comment)}
number of pictures to be viewed during countdown
    picture name
        number of groups for this picture
            {group name}
            {channel names for this group}
{command description list}
    {a list of each requested command step}
    {a description or comment for each command
    step requested}
audio alarm list
    {(by trailer name, channels to have audio
    alarms at TCOM and CP)}
    {(bypass channels)}
    {(ignore channels)}
    {(composite channels)}
        {(analog channels to be composited)}
        {(digital channels to be composited)}
    {(post test report requests)}
        {(requests for any hard copy reports or plots)}
```

3.2.4 User Input During Countdown -

User input during the countdown will be limited to touch panel input for most users in the Control Room.

During post countdown, users will be able to request reports.

3.2.5 Commands -

Automatic and manual commands will be monitored by the Monitor System.

CP (VAX)

All automatic and manual commands for a given event will be monitored directly by the VAX at CP. The VAX will be used for determining the alarm conditions in the Control Room.

The local command step counter will be displayed on all pictures in the Control Room.

Forward Area (TCOMs)

Each TCOM will monitor all automatic commands for all trailers for that particular countdown. For manual commands, each TCOM will monitor only those user requested commands that are sent to the trailer.

Command information is necessary in the TCOM for the purposes of checking local alarm conditions at the TCOM. All command information received by each TCOM will be sent back to the CP along with the monitor information.

As far as the user is concerned, the command system will remain the same in that only the requested manual and automatic commands will be received by each trailer for that user's equipment.

3.2.6 Countdown Status -

The countdown status of the T&C Monitor System will be displayed on all Control Room and TCOM monitors.

3.2.7 IRIG Time -

IRIG time will be read directly by the Monitor System at CP (VAXes) and displayed on all Control Room displays, for all non-countdown modes of operation.

IRIG time will not be available to the TCOMs. TCOMs will use the internal LSI-11/23 clock for time-of-day.

3.2.8 Changing A Channel Status -

Users will be responsible for changing the status of each channel prior to a dry run. (ignore, bypass, normal, audio alarm) These changes can be made any time before a dry run.

Any parameter changes made after a FDR will be performed by the T&C Supervisor, at the users request, and approved by the Test Director and EPE.

3.2.9 Countdown Time -

The countdown time generated by the coder clock will be read directly by the Monitor System at CP and will be displayed on all displays at CP when the Monitor System is in the countdown mode.

The TCOMs will reconstruct the actual countdown time based on the automatic command inputs and the local LSI-11/23 clock.

3.2.10 Time Synchronization, TCOMs -

Each TCOM will synchronize its clock based on the first automatic command. This command will indicate to each TCOM that the countdown has started. At that time, each TCOM will start an elapsed time counter based on the LSI-11/23 clock.

For all modes of operation, except the countdown, TCOMs will use the internal time-of-day clock as set locally by the operator.

3.2.11 Touch Panel -

All displays in the Control Room will be equipped with touch panels. These touch panels will be used to select various predefined pictures during the countdown. A menu of all user defined pictures will be displayed on the bottom of the user display. Any time during the countdown, the user may select one of these pictures. Selection of a picture does not affect the data being monitored.

3.2.12 Special Inputs -

3.2.12.1 Weather Data -

Data from the weather service at CP will be read directly by the T&C Monitor System. The following information will be available to the T&C Monitor System for all twenty (20) weather stations at NTS:

- average wind velocity
- minimum velocity
- maximum velocity
- temperature
- air pressure
- wind direction

3.2.12.2 Geophones -

Each trailer park has two geophones as input. The geophones will be monitored with a separate system.

3.2.13 Trailer Simulation -

The TCOMs will be capable of simulating a trailer in the Forward Area. This is especially applicable to Prompt Diagnostics. A TCOM can be loaded with the appropriate user parameters and then interfaced to the command system, by using the usual digital input channels, without being connected to the actual user signals. This will give the effect that all of the user signals are responding appropriately. In the case of Prompt, those TCOMs which are simulating absent trailers can reside in the 'Frontend Trailer'.

3.3 Processes

3.3.1 Conversion -

Data will be converted from volts to engineering units, where required. Polynomial, table, and linear conversions will be provided.

3.3.2 Threshold Checking For Analog Data -

The user will be able to set a data threshold value for each analog channel. This means that if a given analog channel changes in absolute value relative to the last saved data value by more than a predetermined amount (threshold value), then the new data value will be saved. It is assumed that the user will want this new data value displayed in the Control Room. In the case of dry runs, it will also be displayed on the TCOM system terminal.

There will also be a time threshold for each analog channel. The user will be able to specify that, if after a predetermined period of time, no analog data has been saved for a given channel or set of channels, (the data threshold has not been violated) then the data for that channel will be saved and displayed in the Control Room.

Both the data and time thresholds will be time dependent. For example, data thresholds may change for most channels before and after zero time.

Data thresholds may cause problems if one channel becomes noisy. If this condition occurs, then the channel in question will not be allowed to clog the Monitor System. Some data will still be transmitted for the noisy channel.

3.3.3 Digital Pulses -

Transient digital pulses occur within a time of 25 milliseconds which must be captured and saved. Sometimes users would like to know if these pulses have occurred. The time the pulse occurred will also be saved. The user will have the option of having this information displayed in the Control Room. Each user will have one digital channel at his disposal for this purpose.

Digital pulses, whether they are alarms or expected changes of

state, will be very difficult for users to see on the Control Room displays. A special terminal will be provided in the Control Room which will print out any alarm condition or change in digital channel. The user will also be able to obtain an 'alarm report' after any countdown.

3.3.4 Alarms -

Analog data will be checked for alarm conditions when specified by the user. There will be a minimum and maximum alarm limit. Alarms are an optional feature.

Analog data will be checked for a warning condition. This will be a level which will warn the user that an alarm condition may be approaching. There will be a minimum and maximum warning limit. *Warnings are an optional feature.*

For both alarms and warnings for analog channels, there can be several time periods during the countdown which can have different warning and alarm values. For example, an analog channel can have an alarm value of 100 degrees for the first 10 minutes of a countdown and for the rest of the countdown have an alarm limit of 80 degrees.

The same is true for digital alarms except that the system alarms states rather than values. For example, valid states for a digital channel can be defined as OFF for the first 5 minutes of the countdown, ON for the next 10 minutes, and OFF for the rest of the countdown. Any other states than those defined at the specified times will be alarmed for that digital channel.

Notice that any change in the specified alarm values or states (analog or digital channels) must coincide with a command step. In other words, if the alarm value for an analog channel is supposed to change from 100 degrees to 80 degrees at minus 10 minutes in the countdown, then there must be a command step at minus 10 minutes.

See Alarms in Output section.

3.3.5 Communications Status -

The communications hardware and software in the VAX will determine that the communication with each TCOM is working properly. This information will be made available to the T&C Supervisor, EPE, and Test Director.

3.3.6 Checking The Script -

See the Alarms section in Processes and Outputs.

3.3.7 Composite Signals -

Users will be able to composite both digital and analog data. That is, several digital signals can be combined into one digital monitor and several analog channels can be combined into one analog status. With the analog signals, only the status will be composited.

See Super Composites below.

3.3.8 Comparison Of Data From Run To Run. -

In some cases, users would like to compare the value of a given channel from run to run at specified times during the countdown. This is currently being done with the fill display.

3.3.9 Turn-on Or Up To Speed Time. -

When various devices are given a command, it sometimes takes time for that device to respond. Users will be able to define a time for this transient (third) state in the monitor system. The monitor will turn yellow when it is in this transient state and green once the device has gone to the desired steady state. If after the specified period of time the device does not reach the desired state, it will of course be alarmed (turn red).

3.3.10 System Health -

3.3.10.1 VAX Systems -

The fact that the IRIG time (for all cases except countdowns) is changing is an indication that the VAX is running. During the countdown, the fact that the coder clock is changing is an indication that the VAX is running. During a hold condition, when the coder clock is stopped, the word HOLD will be blinking.

In addition to the IRIG time indicator, a separate audio alarm indicator will be provided in the event that either VAX crashes.

3.3.10.2 TCOMs -

A reference voltage will be provided for each TCOM on analog channel zero (0). Any deviation from this reference value will be an indication that at least the A/D board for that particular TCOM is bad.

In addition, the communications software in the VAX will continuously poll all TCOMs in question. The communications software will, within a few seconds, be aware of the fact that a TCOM has crashed. A real-time status report will be available to the *T&C Supervisor indicating which TCOMs are alive and well*. Notice that if the microwave fades or goes down, communications will be lost to all TCOMs on that link.

In addition, the VAX will black-out all individual channels being displayed if that TCOM crashed. If the TCOM recovers, then all data for that TCOM will be sent to the VAX and the monitors will be restored with the most current data.

3.3.11 Super Composites -

For at least the standard text displays in the control room, there will be the option of creating what could be viewed as a super composite capability. That is, if any monitor in a picture not currently being displayed goes to a warning or alarm state, then the box for that particular picture will turn the warning or alarm color. The user may then touch that box and the picture in question will be displayed.

3.4 Outputs

3.4.1 Display Output -

In general, the viewer will have the ability to view as much or as little as necessary by being able to define several pictures and by being able to define what is on each picture. Each user will have one physical display but will be able to call up several pictures, one at a time by using a touch panel on the display. Color will have a consistent meaning. Currently the various colors have the following distinction:

White = active digital channel which has not yet changed state

Yellow = warning alarm; up to speed state for digitals

Green = active digital channel which has successfully changed state; an active digital channel which is in its correct state where it is not intended to change state during the countdown; an analog channel which is within its alarm limits

Blue = bypass

Magenta = ignore

Red = alarm condition for that channel

Black = TCOM is down

Cyan = an active digital channel which has not yet changed state and is dependent upon a manual command to change the state

The users will have the ability to change the status (active, bypass, or ignore) of any given channel from their TCOM prior to the countdown. Users must allow time for the system to record the status change.

Most displays in the Control Room will be functionally the same. For example, most user displays will have a touch panel. Some displays which will not have touch panels, for example the Fill Display.

The user display in the Control Room will look the same as the displays in the Forward Area. Guidelines and standards have been established for display formats. In some cases, where users have more than one trailer, displays in the Control Room will not look exactly like the displays in the trailer.

3.4.1.1 Control Room Display Assignment -

Each VAX will be capable of displaying twelve (12) unique pictures at one time on twelve (12) different physical monitors.

The following is a list of displays to be generated by the new Monitor System:

1. Test Director	Textual	Standard
2. T&C Sup.	Textual	Standard
3. EPE	Textual	Standard
4. Prompt	Textual	Standard
5. DSE	Textual	Standard
6. ASE	Graphical (2)	Special, fill replacement
7. Containment	Both	Special
8. H&S	Graphical	Special, political
9. H&S	Graphical	Special
10. Special Meas.	Textual	Standard
11. Nuclear Chem	Graphical	Special
12. Aux. Prompt	Textual	Standard
13. Geophones	Graphical	Separate System

The T&C personnel will have the ability to send any picture to any of the following locations:

1. Control Room
2. Visitors Gallery
3. Control Room Loft

4. DOE Observation Room
5. H&S Room
6. The Prompt Observation Room at CP
7. The VAX Terminal Room
8. VAX Machine Room

3.4.1.2 TCOM Displays -

Displays generated by TCOMs will be functionally similar to the displays in the Control Room for each user. Color displays will be provided. In some cases, displays may not be exactly the same for operational reasons. For example, the TCOM displays for Prompt TCOMs may be different than the Control Room displays because Prompt has several trailers. Each trailer can have its own display; however, the Control Room displays may reflect monitors from all Prompt trailers in a different way.

3.4.1.3 Standard Text Display Format (Control Room And
TCOMs) -

```
.....
header
.....
active picture

(70 monitor limit)

.....
|pic0|pic1|pic2|pic3|pic4|pic5|pic6|pic7|pic8|pic9|
|.....|.....|.....|.....|.....|.....|.....|.....|.....|.....|
.....
```

where,

header = event name

status (watchdog, countdown {pre-countdown,
counting, hold, accelerate, abort},
post countdown, verification, simulation,
report generation)

time (countdown = countdown time, non-countdown=
IRIG time)

local command step counter
(countdown only)

active picture = picture identification
channel identification
current channel values
channel units
channel status in color

pic0-9 = menu selection for other defined pictures,
status of pic0-9 given by color

Notice that the TCOM displays will not have the menu selection option.

3.4.1.4 T&C Supervisor Special Display -

The T&C Supervisor will have a special display capability which will allow him to access the following information:

1. information about any channel in the current system, including:
 - user input parameters
 - picture parameters
 - command descriptions lists
 - conversion parameters
 - audio alarm lists
 - post test report lists
2. alarm history (digital and analogs)
3. digital change of state history for all digitals for a given event (there should be an option to send this to the printer)
4. System alive and well report

This will include the following system components:

- all TCOMs
- both VAXes
- the microwave system

This capability will be available to him real-time during the Watchdog and Countdown modes of operation.

3.4.2 Storing Data Real-time/Archival/Retrieval -

All monitor data, including alarms, warnings, and commands, during a countdown will be stored on the VAX disks at CP. This data will be able to be retrieved, in various forms, during post countdown and after the event. Optionally, each user will have the capability of storing monitor information on the TCOM as another form of backup. This will be useful in the event of a communications link failure and/or stand-alone operation.

There will exist the capability to archive selected data channels for up to several days after zero time. This may be for as long as 90 days in case there is venting after a test(TCOMs and VAXes).

After the event, all data will be transferred to magnetic tape for long-term archival and retrieval. Data stored on tape can be later transferred back to disk for post-test processing.

Archived data will include data monitored from D-1 through the countdown and until the event is released.

Monitor data from each dry run can be saved by T&C personnel. Data from SDR's will typically not be saved.

3.4.3 Reports -

Upon request, reports will be generated after zero time for each user at CP. TCOMs will have local report capability as well. Some of the summary post-shot reports will not be available on the TCOMs. These reports will be standardized as much as possible.

3.4.3.1 Plots -

Plots at CP will be provided in black and white as well as color.

The following types of plots will be provided:

1. analog channel(s) vs time over a given time period
2. analog channel(s) vs another analog channel over a given time period
3. digital channel(s) vs countdown time over a give time period
4. digital channel(s) vs command step number.

Plots will have the following characteristics:

1. axis types (lin-lin, lin-log, log-lin, log-log)
2. grid types (hash, full grid)
3. color or different line types for multiplots
4. automatic minimum-maximum axis determination
5. user specified minimum-maximum axis determination

3.4.3.2 Textual Reports -

3.4.3.2.1 Alarm Reports -

This report will summarize any alarms for a given user and/or trailer.

Notice that special terminals will be provided in the Control Room where this information will also be automatically be sent.

3.4.3.2.2 Digital History -

This report will be available to the T&C Supervisor in real-time in both the watchdog, countdown, and post countdown modes of operation. It will also be available to other users in post countdown.

Notice that special terminals will be provided in the Control Room where this information will also be automatically be sent.

The form of the digital report will be as follows:

date, clock time, [countdown time], trailer name, digital channel number, digital channel ID, digital state

3.4.3.2.3 All User Input Parameters -

This report will be a hardcopy of all user input parameters which can be used for verification and can become a permanent record.

3.4.3.2.4 Configuration Report -

This report will describe the current configuration for a given event. This report will be used primarily by the Test Director, EPE, and the T&C Supervisor. It will contain the following:

1. all user names
2. all trailer numbers
3. TCON number for each trailer
4. assigned command system
5. display configuration
 1. list of user displays and location in the Control Room
number and name of each picture for each user
 2. displays for the Visitors Gallery
a list of pictures for each display
 3. displays for the DOE Observation Room
a list of pictures for each display
 4. displays for the loft
a list of pictures for each display
 5. displays for the Prompt Observation Room
a list of pictures for each display
 6. displays for the H&S Room
a list of pictures for each display
 7. displays for the VAX Terminal Room
a list of pictures for each display

8. displays for the VAX Machine Room
a list of pictures for each display

3.4.4 Real-Time Backup -

During a countdown, both VAXes will be monitoring the same data, therefore a real-time backup of all data will exist on the second VAX disk.

3.4.5 Alarms -

See Alarms in the Processes section above.

3.4.5.1 User Alarms -

Audio and visual (turns red) alarms shall be provided for any user analog and digital channels. Notice that both the visual and audible alarms can be disabled.

Audio and/or visual alarms will be provided to the user in the Forward Area. Visual alarms (displays turning red) will be provided to users in the Control Room.

3.4.5.2 Centralized Alarms -

The T&C Supervisor, EPE, and Test Director will have the ability to monitor any channel in the system. Control Room personnel will also be able to audio alarm any channel, composite channel, or super composite in the system. Notice that the alarm panel will no longer be needed due to this capability and will therefore be eliminated. The composite light panel will also be eliminated.

3.4.6 Countdown Status -

The status of the countdown will be on all displays. That is, if the countdown is in a hold, accelerated, or abort condition, then that current countdown condition will be on each display in the control room. The countdown status will also be displayed in the Forward Area, except of course during the event.

3.4.7 Graphics Displays -

See section 3.4.1.1 above.

3.4.8 Units -

Users will be able to have data displayed in engineering units as determined by the user at parameter input time.

3.4.9 Special Output Devices -

3.4.9.1 Geophones -

Geophone data will be displayed via strip charts in the H&S room.

The geophone data display will be standard for all events.

3.4.10 Script Generation -

Based on all of the user parameter inputs, the Script will be automatically generated. The Script will include commands and monitors. This capability will facilitate quick changes to monitor parameters and quicker Script generation.

3.4.11 TCOM Hardcopy Output -

TCOMs will not be supplied with hardcopy output devices. However, an output port will be provided for user supplied hardcopy devices. This port will only provide for textual hardcopy output and not for graphical hardcopy output. Graphical hardcopy output can be obtained from the CP VAX systems.

3.5 System Capacities

The system capacities stated below are the current capacities and known future desires for expansion. A very basic requirement for the T&C Monitor System is that it be designed for change and expansion. The environment at the Test Site is one of change and, for the foreseeable future, one of growth.

3.5.1 Trailer Parks -

The system will be able to monitor four trailer parks at any given time and monitor a selected number of channels from all four trailer parks simultaneously, two trailer parks per VAX. If one VAX is not operational, then only two trailer parks can be monitored.

3.5.2 Number Of TCOMs Per Trailer Park -

Typically there will be 6 to 10 TCOMs per trailer park, with an upper limit of 14. There will generally be one TCOM per trailer.

Special measurements and the Prompt 'Frontend trailer' are exceptions.

3.5.3 Displays In The Control Room -

Each VAX will be capable of generating twelve (12) distinct pictures at the same time.

3.5.4 Visitors Gallery -

The T&C personnel will have the ability to route any picture being displayed in the Control Room to the Visitors Gallery.

There will be no keyboards or touch panels connected to the displays in the Visitors Gallery.

Geophone data will always be displayed in the Visitors Gallery.

3.5.5 DOE Observation Room -

The T&C personnel will have the ability to route any picture being displayed in the Control Room to the DOE Observation Room.

There will be no keyboard or touch panel in the DOE Observation Room.

4.0 OPERATIONAL CAPABILITIES

4.1 General Operational Capabilities

- Each VAX will be able to monitor any Trailer Park in the Forward Area.
- Each VAX will function independent of the other VAX. The only communication between VAXes will be minor status information during countdowns.
- Generally, one VAX will be assigned to monitor two of the four Trailer Parks and will act as a backup for the other two Trailer Parks. Naturally, if only two Trailer Parks are active, then it is assumed that each VAX would be assigned one Trailer Park.
- During a countdown, both VAXes will be monitoring the same Trailer Park, with one acting as the 'hot backup'. The T&C Supervisor will have the ability to 'switch' to the backup at any time.
- For a Signal Dry Run (SDR), the T&C personnel have the option of not running the second VAX as 'hot backup'. In this case, the second VAX could be performing another function for another Forward Area. This is actually true for any countdown situation. The design team is recommending, however, that SDR's should be the only countdown situation where there is no 'hot backup'.
- There will be no attempt in the new monitor system to differentiate one type of run from another, be it either a dry run or event run. The order in which the runs occur or the number of runs scheduled for an event will have no significance in the design of the monitor upgrade. It should be noted, however, that the standard operating procedures (SOPs) for T&C may be different for one type of run versus another, but the monitor system will not be able to distinguish the difference.

4.1.1 Monitor System Modes -

The Monitor System can be in three different modes and within each mode there can be several types of submodes all of which are listed below. For a definition of these terms, see the TCCM DESIGN CAPABILITIES and VAX DESIGN CAPABILITIES sections below.

1. Operations mode:

- Configuration.
- Configuration verification.
- Calibrations.
- Watchdog (event monitoring during non-countdown periods).
- Countdown (primary and back-up modes).
- Post Countdown
- Event report generation.
- Event simulation/demonstration.

2. Maintenance Mode:

- System back-up.
- Preventive maintenance.
- Remedial maintenance (hardware/software).

3. Development Mode:

- System enhancements (hardware/software)
- Vendor product updates (hardware/software)

There will never be concurrent support of the operations mode, the maintenance, and the system development mode, on a given machine (VAX). This does not pre-empt the second machine (VAX) from providing event support in the operations mode, except when both machines are required synchronously for a countdown. The only areas of concern, then, for support of concurrent activities, lie within the confines of the operations mode.

4.1.2 TCOM (Forward Area) DESIGN CAPABILITIES: -

4.1.2.1 Installation -

A TCOM will be installed in every event trailer that requires monitoring. The Special Measurements (Containment) Trailer will require two TCOMs, one for the high side and one for the low side. Installation (and maintenance) will be performed by T&C personnel. For a complete list of TCOM hardware and software, see the section on PACKAGING.

4.1.2.2 Booting -

Each TCOM can be booted as a standalone system or as a remote node of either VAX at CP.

4.1.2.3 Standalone TCOM Operations Activities (Operations Mode) -

Each TCOM can perform some activities in a standalone mode prior to the installation of the T&C Communications Microwave Link to the trailer park.

Each TCOM will be able to perform part or all of the following activities in a standalone (no communication link to CP) mode. Only one activity can be loaded and run at a time. A new activity can be loaded from a floppy disk or can be downline loaded from CP if the communication link is established.

4.1.2.3.1 Configuration Of TCOM -

The intent of this activity is to generate/modify parameters that will instruct the T&C Monitor System as to which user analog and digital inputs exist, what the conversion parameters are for each of those channels, and how the acquired data should be displayed in the trailer on the terminal during countdowns. For a complete list, see the User Input Parameters section under Inputs. This activity will be a replacement of the current requirements

sheets which are now given to T&C personnel.

User parameters for a given event will be frozen four (4) weeks before the first SDR. This means that any changes to user parameters after this time must be cleared thru the T&C personnel. The user is still responsible for making the appropriate changes in parameters which will in turn be verified by T&C personnel.

T&C personnel will be able to change any user parameter in the system but they will not make any changes to user parameters without the consent of the user, the Test Director, and the EPE.

4.1.2.3.2 Verification Of The TCOM -

This activity will enable the user to test that the configuration parameters have been properly established for the TCOM. By watching the monitor and varying the analog and digital input lines, the user can also verify that:

1. channel assignments are correct.
2. conversion parameters are correct.
3. signal level verification
4. alarm limits are correct for all countdown times and states.

4.1.2.3.3 Calibration Of The Users' Signals -

This activity enables the user to establish conversion parameters by performing field calibrations with the TCOM. The user:

1. establishes a known calibration point for a channel, enters the converted value (in engineering units) into the TCOM, and then prompts the TCOM to record the raw value. The process is repeated for the desired number of points and for the desired channels. The TCOM then generates the conversion

coefficients or lookup tables for each channel specified.

2. is provided with calibration plots and statistical information on the terminal to determine the acceptability of the calibration.

4.1.2.3.4 Watchdog -

The user will invoke this capability when there is a need to monitor the user's signals when not in a countdown mode. The user is provided with:

1. real-time display of monitor signals.
2. time-history plots (data archiving) of monitored channels. This feature may be invoked for unattended operation of user systems (nights and weekends), or for attended use.

4.1.2.3.5 Simulated Countdown -

A simulated countdown will be provided for the TCOM in a stand alone mode. This will be provided only for the Monitor system and will not generate command signals. This will be a capability where the user will be able to 'single step' through a countdown by using the terminal.

4.1.2.4 Remote Node Operations Activities -

Each TCOM will be capable of communicating to the VAXes at CP via DECnet. Communication port "A" will talk to VAX "A" and port "B" will talk to VAX "B". One port will serve as a primary port and the other as a backup port. The "A" and "B" ports will always communicate with the VAXes via separate microwave communication links.

Once the communications link is established, CP has overriding control of the TCOMs mode of operation. This means that each user will still be able to run in any mode they want by loading the appropriate floppy, however, CP can,

at any time, overwrite the current mode in any TCOM by downline loading software and transfer parameters which will put that TCOM in the same or another mode of operation. There will be coordination between CP and all users in this case.

The VAXes can invoke all of the standalone activities and the following activities for a given TCOM:

1. Configuration of CP
2. Verification of CP. (NOTE: Verification may be a subset of the dry run countdowns.)
3. Countdown
4. Upline loading of user parameters from a selected TCOM to the VAX. (transfer user parameters from the TCOM to the VAX)
5. Via DECnet, T&C personnel can access a VAX from the terminal on any TCOM.
6. TCOMs will not be involved in event report generation or event simulation.
7. Transfer user parameters from the VAX to the TCOM.

4.1.2.5 Maintenance Activities (Maintenance Mode) -

Units will be repaired at the board level in the field as much as possible. Calibration and major repairs will be completed at the NLVF.

Diagnostics and user-signal simulators will be provided. Diagnostics can be downline loaded or booted remotely.

4.1.2.6 Development Activities (Development Mode) -

Development for the TCOMs will be performed on a separate system and completely tested before put into the field. This activity will be held to a minimum.

4.1.3 VAX (CP) DESIGN CAPABILITIES -

An operators terminal will be provided which will allow the T&C personnel to change the mode of operation for the VAX systems and therefore the entire T&C Monitor System. There will be a protection device via software which will prevent unauthorized personnel from changing the mode of operation.

4.1.3.1 Standalone VAX Operations Activities (Operations Mode) -

A VAX system is considered to be in a standalone configuration when there is an absence of communications to any of the TCOMs. A hardware link may be established, but the communications (DECnet) software on the VAX or any TCOM will not be active.

4.1.3.1.1 Configuration Of The VAXes (CP). -

This activity involves integrating all of the TCOM and VAX configuration parameters. In other words, all user parameters will be combined with any Control Room parameters. This work will be performed by T&C personnel.

4.1.3.1.2 Verification Of The CP Configuration. -

After an initial configuration, the VAXes and peripherals at CP will be checked for proper configuration. The TCOMs are not on line with the VAXes when performing CP configuration as this is a standalone activity.

4.1.3.1.3 Report Generation. -

At times, there will be a need to generate hardcopy records of performance information, event parameters, or monitor data for the user or for T&C personnel. The report generation activity will serve the purpose of generating this information on paper or on magnetic storage media (floppy disk or magnetic tape).

4.1.3.1.4 Simulated Countdown (demonstration). -

By definition, this activity is performed without the TCOMS. This is an activity that will serve two purposes; one will be to demonstrate to visiting dignitaries the monitor system output generated from a typical countdown, and the second purpose will be for checkout and verification of parameters in the VAX.

The only concurrent activities on a VAX can be Configuration, Verification, Calibration, and Report Generation, in any combination, and only when supporting a single event.

A VAX can have activities and data bases for no more than two events at any given time (called Events #1 and #2 on VAX A, and events #3 and #4 on VAX B).

The only concurrent activities in support of two events on a VAX will be any one of the following combinations:

VAX Standalone Concurrent Activities

		E V E N T # 1					
		Config.	Verify	Demo.	Cal.	Rpt. Gen.	
		Config.	X	X	X	X	
E V E N T # 2	Verify	X					X
	Demo.						
	Cal.	X					X
	Rpt. Gen.	X	X		X	X	

4.1.3.2 Integrated Systems Operation: (VAX And TCOMs, Operations Mode) -

Once a communication link is established and active between a VAX and any number of TCOMs, that VAX is considered to be in the integrated systems mode and each TCOM is in the remote node mode. One VAX can be in the standalone mode while the other VAX is in the integrated systems mode.

The CP monitor host system (two VAX-11/750s and supporting peripherals) will be capable of providing support in varying degrees to 4 events. Configuration of a fifth event will not be possible until the 4th event is completed and the monitor system is released from supporting that event.

Each CP monitor host VAX will be configured for no more than two events at a time in a non-countdown mode. All information for one event will be configured on a single, removeable, disk pack.

Each VAX will be able to have up to 14 TCOMs per trailer park

and two trailer parks for a total of 28 TCOMs per VAX. Due to throughput limitations, one VAX will only be able to communicate with one trailer park in the countdown and post countdown modes of operation. For all other modes of operation, one VAX will be able to communicate with two trailer parks at the same time.

The following activities can occur with the VAX in the integrated systems mode:

4.1.3.2.1 Integrated Verification -

This activity is preceded by the TCOM and VAX verifications. The requirement here is to verify the communication links and configuration of each TCOM for an event.

4.1.3.2.2 Calibration -

No calibration software will be provided for the VAX systems. Users or T&C personnel will of course be able to monitor channels in the Watchdog mode and perform calibrations manually at CP, if necessary.

4.1.3.2.3 Watchdog -

This is a time-independent activity that monitors event systems during non-countdown periods. This activity will typically be invoked for overnight and weekend monitoring when systems are running and unmanned. Users will receive summary reports of problems and be able to call for data listings and time-history plots from the TCOM or VAX system.

4.1.3.2.4 Countdown -

This activity is initiated by the T&C Supervisor prior to sending the first manual or automatic command sent from the Command System and continues until the last automatic command is sent. In the countdown mode, the monitor system has the capacity to hold, accelerate, and reset (abort) synchronously with the Command System. This is a real-time activity with user interaction available during the acquisition, processing, and display generation of monitor data.

4.1.3.2.5 Post Countdown -

This activity is a continuation of the event countdown activity; is similar in its functions, and continues until release of the monitor system by the Test Director. The expected time period is a few minutes for dry runs and up to three (3) days for event runs. This activity is invoked automatically by the software when the last automatic command is sent. Notice that if there is venting, that the post countdown activity could last for 90 days.

Some users will have channels for which it will not be necessary to record. Those channels will be identified ahead of time and will not be recorded past a pre-determined or user specified amount of time into plus time.

4.1.3.2.6 Report Generation -

This is an activity where reports are generated of event system monitor data from countdown, plus-time, and/or watchdog activities. The reports will either be on paper or magnetic storage media (floppy disks or magnetic tape).

When report generation is running concurrently with post countdown, reports can only be generated for the current event. Reports for past events can be generated concurrently with any activity except countdown and post countdown for another event.

For a single VAX, supporting a single event, the following combinations of activities can occur:

VAX Integrated Concurrent Activities
 SINGLE EVENT

		E V E N T # 1				
		Intgrtd. Verif.	Wtchdg.	Ctdwn.	Post Ctdwn.	Rpt. Gen. Cal.
		Intgrtd. Verif.	X			X X
E V E N T	Wtchdg.	X				X X
	Ctdwn.					
#	Post Ctdwn.					X
1						
	Rpt.Gen.	X	X		X	X
	Cal.	X	X			X

or

Integrated verification	-	1	
Watchdog			>
Report generation		1	
Calibration	-	1	

Any combination

For a single VAX, supporting two events, the following combinations of activities can occur:

VAX Integrated Concurrent Activities
 TWO EVENTS

		E V E N T # 1				Rpt. Gen.	Cal.
		Intgrtd. Verif.	Wtchdg.	Ctdwn.	Post Ctdwn.		
	Intgrtd. Verif.	X	X			X	X
E V E N T	Wtchdg.	X	X			X	X
	Ctdwn.						
#	Post Ctdwn.						
2	Rpt.Gen.	X	X			X	X
	Cal.	X	X			X	X

If there are four active Forward Areas, then after a FDR only three Forward Areas will be monitored; the Forward Area which just completed the FDR will be totally dedicated to one VAX and the other two Forward Areas will be monitored by the second VAX.

4.1.3.3 Maintenance Mode -

4.1.3.3.1 System Back-up -

At predetermined times, the system and/or the event disks will be copied to another storage media (disk or tape) as a precautionary measure to reduce the risk of losing programs and data.

4.1.3.3.2 Preventive Maintenance -

This is a routinely scheduled activity to check for potential problems and service equipment that requires periodic adjustment, cleaning, or parts replacement.

4.1.3.3.3 Remedial Maintenance -

This involves the repair of defective equipment.

4.1.3.4 Development Mode -

After the upgrade system is turned over to operations personnel for production (event support), there may be times when previously undetected hardware or software problems surface, or general enhancements of vendor's products may warrant making changes to the system. If a change is made to correct a problem, it will be considered a maintenance activity, and if the change is an enhancement, it will be considered a development activity. Notice that a VAX which is in the development or maintenance mode cannot be in the operations mode and therefore cannot support an event during this period of time. Development and maintenance activities will occur on one VAX at a time such that the event schedule will not be affected.

4.1.3.5 Synchronous Operations -

At the CP, both VAXes will be required to run synchronously (in parallel), one in the primary mode and one in the back-up mode for the following activities:

1. All mandatory dry runs (MSSR, HDR, FPDF, DCR, and FDR),
2. All event runs.

Each VAX will be collecting and processing data from the TCOMs, but only the output from the primary VAX will be routed to the displays. An exception to this will be the T&C Supervisor's Display. The T&C Supervisor will be able to select either VAX for output to his display. This will allow the supervisor to monitor the readiness of the back-up system during the runs.

When both VAXes are working synchronously for a single event, the following combination of activities can occur for that event on the primary VAX:

Post countdown and Report generation.

The turnaround time of the CP monitor system from one mandatory run to another mandatory run will be no longer than 20 minutes.

4.1.4 System Failures -

The consequences for the failure of major monitor system components are discussed below:

4.1.4.1 TCOM (Forward Area) -

4.1.4.1.1 Terminal -

Stand-alone Mode

In the stand-alone mode, if the terminal fails then the system is not useable. T&C personnel should be called in order to repair or replace the terminal.

Integrated Mode

In the integrated mode, the terminal will be active for all operational modes except for the event. Failure of the terminal during a dry run will only inhibit local viewing of data. The monitor system will continue to function and collect data locally and at CP.

4.1.4.1.2 Mass Storage Device (floppy) -

Stand-alone Mode

The current mode of operation will continue to run. If data was being stored, it of course will no longer be stored. Data which has been written to the disk up to the time of failure may be able to be recovered, depending on the type of disk failure. Local booting capability will be lost and the operator will not be able to change operating modes. Downline loading of operating modes and user parameters will be possible.

Integrated Mode

Failure of the disk during an integrated mode of operation means that local data will no longer be able to be stored. The monitor system will continue to function and no apparent degradation in performance should be noticed.

4.1.4.1.3 A/D Converter Board -

Any failure of an A/D board will cause a loss of analog data for that particular user. The monitor system will continue to function as a whole. Monitoring of digital data will not be affected.

4.1.4.1.4 Digital Input Board -

Any failure of a digital board will cause a loss of digital data for that particular user. The monitor system will continue to function as a whole. Monitoring of analog data will not be affected.

4.1.4.1.5 Communications Board (output To The VAX) -

Each TCOM will have two communications boards, if one board fails, then the T&C Supervisor can switch the entire system to the backup VAX which will use the other communications board.

4.1.4.1.6 LSI-11/23 -

An LSI-11/23 failure can occur in either the CPU or memory boards. If either fail, then that particular TCOM will be lost. The defective board must be replaced in order to reactivate the TCOM.

4.1.4.2 Communications System -

4.1.4.2.1 Microwave Fade/failure -

Each VAX will have at least two microwave links. If one of the primary links fail, then the T&C Supervisor can switch to the backup VAX which will be using the other communications link.

4.1.4.3 VAX (CP Systems) -

4.1.4.3.1 Displays -

If a display fails, the T&C Supervisor can redirect the pictures for that particular user to a spare display monitor by using the configuration file. A video switcher will be used in the assignment of pictures to displays and this will be used to redirect the pictures for display monitor failures.

4.1.4.3.2 Graphics Processor -

Each VAX will have one graphics processor. If the graphics processor fails on the primary VAX, then the T&C Supervisor can switch to the backup VAX.

4.1.4.3.3 Mass Storage Device (RM03 Disk) -

Each VAX will have two RM03, 67 megabyte, disk units which will be used for archiving monitor data. If a disk on the primary VAX fails, then the T&C Supervisor can switch to the backup VAX.

4.1.4.3.4 Communications Board (Input From The TCOMs) -

Each VAX will have two communication boards, if one of the communication board on the primary VAX fails, then the T&C Supervisor can switch to the backup VAX.

4.1.4.3.5 Printer/Plotter (black And White) -

Each VAX has a printer/plotter which will be used during the report generation activity. If the printer/plotter fails during the post countdown activity, which can run concurrently with the report generation activity, then the

T&C Supervisor can switch to the backup VAX. However, the failure of the printer/plotter is not considered a critical system component failure. No monitor data will be lost due to a failure of the printer/plotter. The T&C Supervisor, with concurrence from the Test Director and EPE, can choose not to switch to the backup VAX if the printer/plotter fails.

4.1.4.3.6 Color Plotter -

Each VAX has a color plotter which is used during the report generation activity. If the color plotter fails during the post countdown activity, which can run concurrently with the report generation activity, then the T&C Supervisor can switch to the backup VAX. However, the failure of the color plotter is not considered a critical system component failure. No monitor data will be lost due to a failure of the color plotter. The T&C Supervisor, with concurrence from the Test Director and EPE, can choose not to switch to the backup VAX if the plotter fails.

4.1.4.3.7 Video Switcher -

The video switcher is a computer (VAX) controlled device which will be used to direct pictures, generated by the Grinnell graphics processor, to the various location at CP. The video switcher will also be used to redirect pictures if a display fails. A hardware patch panel will be placed in parallel with the video switcher and will only be used in the event that the video switcher fails.

4.1.4.3.8 Touch Panel Switcher -

The same recovery technique used for the video switcher will be used for recovering from touch panel switch fails.

4.1.4.3.9 Local DAC Switcher -

The same recovery technique used for the video switcher will be used for recovering from DAC switcher fails.

4.1.5 Power Failure -

4.1.5.1 TCOMs -

The TCOMs will be designed such that for any power failure or spike in the power line, which will cause the LSI-11/23 to crash, the system will automatically restart when the power comes back up or stabilizes. Data which has been written to disk will not be lost. Any data which is in memory when the power fails will be lost. The software will be written so that the loss of data, due to power failure, will be minimized.

If there is a power failure during any countdown, the LSI-11/23 system will be manually downline loaded and automatically restarted from the VAX and will continue the monitoring activity. The power failure/recovery cycle, not counting the power down time, will take about 1-2 minutes.

4.1.5.2 VAX Systems -

The VAX system will be designed such that it will automatically restart after a power failure. Any data which is in memory at the time of the power failure will be lost. The software will be written so that the loss of data, due to power failure, will be minimized. Notice that the amount of time that data is in the VAX memory before it is written to disk is on the order of milliseconds. The amount of data which is lost will be a function of the length of power outage and the recovery time. Recovery time, once the power is up, will be 30 to 60 seconds.

4.2 Set Up

4.2.1 Set Up Verification -

See Standalone TCOM Operations Activities

4.2.2 Independent Set Up Of The Forward Area -

See Standalone TCOM Operations Activities

4.2.3 Freezing Monitor And Display Parameters -

User parameters for a given event will be frozen two (2) weeks before the first SDR. This means that any changes to user parameters after this time must be cleared with the T&C personnel. The user is responsible for making the appropriate changes in parameters which will in turn be verified by T&C personnel.

4.3 Calibrations

4.3.1 Auxillary Systems Calibration -

4.3.1.1 Pre-event, General -

The transducer electrical performance must be verified.

Observe rise-time of fill in order to check for dirt or any other problems in system gas lines.

Check for system leakage by looking at level portion of the fill plot.

Check for consistency from dry-run to dry-run.

Monitor temperature changes during fill.

4.3.1.2 Transducer Calibration (TD Cals) -

Usually calibrated one or more times prior to the HDR.

Output from calibration labeled with the following:

Event Name

TD CALS

date

Transducer number

Transducers usually have an offset of about .5 volts, therefore the recording device must allow for this offset.

Currently the Red Shack communicates with the CCC personnel via phone in order to perform the calibration.

The Red Shack will state the current pressure level and the CCC personnel will record that level on the strip chart.

There are usually 6-12 calibration levels or steps from zero psia to 3-4 steps past the transducer working pressure.

Once the highest calibration level is reached, it is held there for about 5 minutes in order to check for leaks in the system.

The systems is then stepped back down 6-12 steps to 0 psia.

4.3.1.3 Auxillary Systems, Dummy Run -

Output labels for Dummy Run are as follows:

Event Name

Transducer number

Date

'Dummy Run'

Voltage at steady state, (when it levels off)

T and C initiates a manual fill command to 1/2 of pressure for calibration in the first half of the run. Voltage ranges

from 2.45 to 2.7 volts. This value is saved for later use.

Gas is released into dummy receiver in the second part of the run. This simulates the fill and helps checkout the system.

4.3.1.4 Baseline Voltages -

Baseline transducer voltages are logged on a separate log for users for each SDR and after the HDR. Each recorder is currently labeled with the transducer number and the approximate working pressure. This pressure is CLASSIFIED and is removed for uncleared visitors.

4.3.1.5 Event -

Compare HDR fill during the event looking for consistency.

Currently ASE labels the strip chart with the countdown time in order to follow each squib, firing, and fill.

4.3.2 X-unit-Hi-Voltage Calibration -

Below is a description of the calibration process for the X-unit-Hi-Voltage.

4.3.2.1 Prior To FFFF -

The Red Shack communicates with CCC personnel via phone currently in order to perform the calibration. The personnel in the forward area verbally tell CCC personnel what KV level they are sending and the CCC personnel record that level on the strip chart.

The following labels are on the strip chart:

Event name

date

X-UNIT-HV

X-UNIT Calibration

Recorder calibrated at zero and full scale. 0-5v = 0-XKV.

Several steps of voltages are recorded on the strip chart. This is done by the Red Shack verbally telling the CCC personnel that the current voltage level corresponds to 'XKV'. The CCC personnel actually write the current equivalent 'XKV' value on the strip chart.

4.3.3 Temperature Calibration -

Calibration for temperature is similar to the calibration for the X-unit- Hi-Voltage. Temperature is calibrated prior to going down-hole.

4.3.4 Health And Safety RAMs Calibration -

Typically there are nine (9) RAMs on a given event, unless Gas Sampling is participating then there are eighteen (18) RAMs on the event. Each RAM is calibrated in the field using a reference at 1, 10, 100, and 1000 Rems. These values are used to generate a conversion table for each RAM. For each RAM, the distance and bearing from ground zero must also be entered into the system.

Notice that the actual RAMs are not placed in the field until 2 or 3 days before the event. Until then, mock values are used in the Monitor System.

Also notice, from time to time RAMs will have to be replaced in the field, which means that they will also have to be calibrated.

4.4 Pre-countdown

4.4.1 Check List -

Check lists will be established for the Forward Area systems and the systems in the Control Room. These check lists will include the hardware and software for the entire system.

Where appropriate and feasible, diagnostics will be run on the hardware and software. See the section on reliability.

Test cases for the software will be included in the check lists.

Before each dry run or countdown, a procedure will be established in order to verify that the entire system, including all of the TCOMs, the microwave, the networking, and the CP software and hardware are operational.

4.4.2 Long-term Pre-countdown Monitoring -

See Watchdog under TCOMs and Integrated Systems Operations

4.4.3 Event Configuration -

T&C personnel will have the capability of configuring events by using either VAX at CP. Several areas of information need to be addressed by the T&C personnel which are of a global nature related to user input. Event configuration will be a process to determine the level of preparedness as well as a method for allocating system resources. The areas below will be covered by the event configuration process.

4.4.3.1 Display Assignment - Physical assignments of all displays will occur in this section. Display assignment for the following areas will be possible:

1. Control Room
2. Loft
3. Health and Safety Room
4. Visitors Gallery
5. DOE Observation Room
6. Prompt Observation Room

4.4.3.2 TCOM Assignments -

Each user will have an associated TCOM. This assignment will have to be made by the T&C personnel so that the Monitor System will be able to associate a particular TCOM with the correct user.

4.4.3.3 User Parameter Input Status -

T&C personnel will be able to determine at a glance the status of parameter input for each user. This will also allow quick looks at the parameters of each user to help in the verification process.

4.4.3.4 Script Review -

The T&C personnel will be able to quickly look at the script, based on updates or recent changes to user parameters.

4.4.3.5 Primary VAX Selection -

A VAX will be selected as the primary monitoring VAX for that particular event.

4.4.3.6 Channel Status -

A quick look capability for a give channel status (bypass, ignore, audio alarm, etc.). This will be a available by channel, trailer (TCOM), user, and system.

4.5 Countdown

4.5.1 Input -

4.5.1.1 Command Steps -

See Input Command Steps under Functional Design

4.5.1.2 Bypass And Ignore Equipment -

See Changing A Channel Status under Functional Design

4.5.2 Processes -

4.5.2.1 Simulated Countdown -

See Simulated Countdown under Standalone VAX Operations Activities

4.5.2.2 Minimum Turnaround Time -

See General Operational Capabilities and Synchronous Operations

4.5.2.3 Countdown Hold -

The system will display the word HOLD on all displays in the event of a hold condition. Any real-time plots which might be affected by the hold condition will also be adjusted. The minimum hold time will be a few seconds while the maximum hold time would be two hours.

4.5.2.4 Countdown Acceleration -

The system will display the word ACCELERATE on all displays in the event of an accelerated countdown condition.

4.5.2.5 Update Monitor Data -

WILL NOT BE IMPLEMENTED

4.5.2.6 "System Up" Indicator -

See section on system health.

4.5.3 Output -

4.5.3.1 Consequences Of Hold And Accelerated Countdowns -
WILL NOT BE IMPLEMENTED.

4.6 Post Countdown (Plus Time)

See Post Countdown and Report Generation under Intergrated System Operations.

5.0 SYSTEM PERFORMANCE

5.1 Data Rates

The data rates stated below assume that one VAX will be reading data from one trailer park for that particular countdown. One trailer park will have no more than 14 trailers where there is generally one TCOM per trailer, 64 analog channels and 96 digital channels per TCOM.

5.2 Changes In Analog Data

The throughput of the system will be sufficient such that any change in any given analog channel can be detected in the TCOM, sent to the CP System via the microwave link, and displayed to the user in the control room, in at least 500 milliseconds.

5.3 Changes In Digital Data

There will be two types of monitoring for digital channels. One type will be the detection of level changes for a given digital channel. The change to the new level must be sustained for more than 500 milliseconds. Usually this change in level will only occur once during a countdown sequence.

The second type of monitoring for digital channels will be able to detect a momentary change from one level to another and then back to the original level. The scanning rate for the TCOM and the total system throughput will be sufficient such that any transient change in any given digital channel, which is between 25 and 500 milliseconds in duration, can be detected. This change in any digital channel can be sent to the control room in a more relaxed time period, on the order of 500 milliseconds. Notice also that transient digital signals are usually rare within one countdown.

6.0 RELIABILITY

The entire system will be reliable, where economically feasible, to the extent that the effect of a single-point failure will be minimal on the ability to perform the monitor function. Notice that between device tests, there will be an emphasis on preventive maintenance and diagnostics for all major components in the system.

Multiple concurrent system component failures will, in most cases, cause a switch to the backup system. Allowances will not be made for multiple concurrent failures in both the primary and backup systems.

6.1 Administrative System Controls

The Test Director, EPE, and T&C Supervisor will be notified prior to any changes in the T&C Monitor System. This includes modification to hardware, systems software or applications software.

Only T&C personnel will be allowed to make modifications to the applications software. Modifications to the hardware will be made by T&C personnel or the vendor.

6.2 Event Interaction

Set-up or dry runs for one event will not decrease the reliability for another event which has completed the set-up phase.

7.0 INTERFACE DEFINITION

7.1 User Signals To The Timing And Control Operations Monitors

7.1.1 Analog Signals -

Channel Capacity: Channels with 64 pseudo-differential or 32 full-differential inputs; expandable to 128 or 64 channels respectively within the existing chassis. Channel zero (0) will be reserved for a reference voltage to be used by the system.

Signal Source Impedance: 1K ohms or less with full differential input line imbalance less than 1K ohms.

Input range: +/- 10 Vdc (normal plus common mode) into an input impedance greater than 5 megohms.

Resolution: 5 millivolts

Absolute Accuracy: +/- 10 millivolts over entire range for 6 months at 23 degrees C plus or minus 5 degrees C.

Sample Rate: 2 samples per second per channel or faster.

Filtering: none.

7.1.2 Digital Signals -

Channel Capacity: 130 (minimum) expandable to 196 channels within the existing chassis. A minimum of two of the channels shall be programmable to interrupt the CPU whenever the input changes (four channels for 196 channels).

Signal Source Characteristics: TTL open collector/drain

TTL turn-on: 0.0 Vdc minimum; 0.8 Vdc maximum

TTL turn-off: 2.0 Vdc minimum; 5.5 Vdc maximum

Contact (relay) closure

Contact on

resistance: less than 20 ohms to ground.

Contact off

resistance: greater than 10K ohms to ground.

Static Input Characteristics: Sense bi-state levels (on/off and open/closed)

Open circuit voltage seen by source equipment: 4.5 Vdc minimum; 5.5 Vdc maximum.

Input resistance: 3K ohm to 5K ohm nominal.

Sample Rate: 2 samples per second per channel

Alarms: go/no go and time dependent

7.2 Command System

Digital inputs will be used to interface the monitor system with the command system. Automatic commands will be interfaced to one digital input channel. Each manual command will be interfaced to a unique digital channel.

7.3 Timing And Control Operations Monitors (TCOM) To The CP System

Software

DECNET

Hardware

DMV-11 for the TCOMs, DHP-11 for the CP System

The monitor system will provide 2 to 4, 56k bps, full duplex, synchronous lines between each trailer park and the CP.

7.4 Timing And Control Monitors To The Microwave Communications Monitor

The monitor system will interface to the Microwave Communications Monitoring System with standard analog and digital inputs.

7.5 Nuclear Chemistry

There will be no interface to Nuclear Chemistry other than the normal analog and digital inputs.

7.6 The DAC System

The current DAC System will be replaced by the New Monitor System.

7.7 Device CAM System

The interface to the Device Command and Monitor (CAM) System will consist of analog and digital signals. In addition, the CAM System will generate a PCM signal which will be read by the TCOM in the Red Shack.

7.8 HPDS

Interfacing to the HPDS system will consist of analog and digital signals.

8.0 ENVIRONMENT

8.1 CP Computer System(s)

An air conditioned environment will be provided for the CP computer systems.

Adequate floor space will be provided in the CP.

Uninterruptable power supply (UPS) systems will be provided in the CP.

8.2 Timing And Control Operations Monitors (TCOMs)

8.2.1 Operating Environmental Requirements -

Temperature: 10 to 40 degrees C. (trailers)

Humidity: 20 percent to 80 percent, non-condensing (trailers)

Altitude: Sea level to 7500 feet

Shock: 10 g's for 35 milliseconds

The Timing and Control Operations Monitors will be mounted in racks which are located in portable trailers. These trailers are transported from event site to event site as well as to the E.G. and G. Atlas Facility in Las Vegas. They therefore experience a considerable amount of shock and vibration from the various road conditions. There is also, of course, the shock of the actual event. The shock and vibration figures given above allow for all of the anticipated environments.

Close quarters - The trailers used in the Forward Area are relatively big, however they also contain a tremendous amount of equipment. As a result, there is not much room in the trailers for extra equipment or people.

8.2.2 Storage And Shippage Environmental Requirements -

Temperature: -20 to 60 degrees C

Humidity: 0 percent to 95 percent, non-condensing

Altitude: Sea level to 30,000 feet

Shock : 10 g's for 35 milliseconds

Vibration: 3 g's over 0 to 50 Hz

9.0 PACKAGING

9.1 CP Computer System(s)

Two VAX-11/750 systems will reside at CP-9 and each will have the following configuration:

VAX-11/750, hardware

- 8 megabytes of memory
- 2 DMP-11 communication boards
- 1 DZ-11 serial interface boards
 - to be used to interface local software development terminals
 - to be used for interfacing T&C Supervisor status terminal
- 1 multi-channel asynchronous communications board
 - to be used for touch panel input
- 2 RM-03 disk drives (67 megabytes each, removable)
- 1 RM-05 disk drive (256 megabytes, removable)
- 1 TU-77 magnetic tape unit, 9 track
- 1 RX-02 dual floppy disk, double density
- 1 LA-120 console terminal
- 1 LXY-21 printer/plotter
- 1 color plotter
- 1 DR-11/W
 - one to communicate with the 12 channel Grinnell graphics processor
- 2 DMR-11 1 megabit communications boards,
 - one to communicate with the other VAX
 - one to communicate to a local LSI-11/23
- 1 Floating point accelerator
- 1 Memory battery backup (good for 10 minutes)

SOFTWARE

VMS operating system
PASCAL will be the implementation language
DECNET will be used as the communications software
Datatrieve will be used for some post-event data management
FMS will be used for forms creation by the parameter input software
CMS and MMS will be used for software development and maintenance

9.2 Timing And Control Operations Monitors

The monitor systems which will replace the User/Encoders will be called Timing and Control Operations Monitors (TCOM's). They will be comprised of the following hardware:

LSI-11/23

512K bytes of memory

64 channels pseudo-differential or 32 channels of full differential (analog)

expandable to 128 or 64 analog channels respectively

1 asynchronous communications board (2 ports)

1 floppy disk controller

130 channels of digital input, expandable to 196 channels

2 communication boards (one for each VAX at CP)

dual floppy disk unit

color graphics terminal

RSX-11/S will be used as the operating system

OMSI PASCAL will be the implementation language.

DECNET will be used as the communications software.

All units of the TCOM will be rack mountable and require about 24 inches of rack space.

A 'stripped down' version of the TCOM will be available which will be comprised of:

LSI-11/23

512K bytes of memory

64 channels pseudo-differential or 32 channels of full differential (analog)

expandable to 128 or 64 analog channels respectively

130 channels of digital input, expandable to 196 channels

2 communication boards (one for each VAX at CP)

This 'stripped down' TCOM will be in one chassis and require about 8 inches of rack space.

Notice that with the stripped down version of the TCOM the following capabilities are lost:

1. local monitoring (no local alarms)
2. local data archival

3. parameter input (configuration)
4. parameter modification
5. calibration
6. local verification and checkout
7. local watchdog monitoring and audio alarms
8. independent operation

10.0 TEST PLAN

10.1 Test Plan Purpose

1. verify that the development phase of the project has been completed properly
2. the requirements will be the basis for the test plan
3. to verify continued operation of the system prior to a dry run or event
4. to verify system operation following any modification of either hardware or software
5. the test plan will be flexible and expandable in order to include tests for any addition to the system

See the Test Plan, which is yet to be published, for more details.

10.2 The System Test Plan Will Include

1. power down of the Timing and Control Operations Monitors in order to show recovery from a power failure in the trailer
2. switch to the backup microwave system
3. cause a fade in the microwave system
4. cause all channels to send data from the Forward Area
5. cause selected channels to send data from the Forward Area
6. a complete power up sequence in the CP systems
7. power down the primary CP system
8. all countdown scenarios
9. verify the time and data threshold capability

10. verify alarm conditions for analog channels

See the Test Plan, which is yet to be published, for more details.

10.3 Unit (module) Test Plan

See the Test Plan, which is yet to be published, for more details.

11.0 REQUESTED CAPABILITIES WHICH WILL NOT BE IMPLEMENTED

1. Taking corrective action in the forward area based on monitored information will not be implemented.
2. Remote monitoring from LLNL will not be implemented.
3. Consequences of a hold, accelerated, or aborted countdown will not be made automatically available to the Test Director, EPE, and T&C Supervisor during a countdown by using the new Monitor System.
4. The new monitor system will not treat a countdown acceleration, hold, or abort in any special way. The occurrence of command steps will cause the monitor system to potentially react to alarm situations. Therefore, an accelerated countdown simply causes command steps to occur more quickly than expected, a hold will cause the monitor system to suspend. There are a few exceptions to this philosophy, the Fill Display being one of them.
5. Up-date monitor data during a countdown. The ability for a user to force the updated value of an analog channel to be displayed in the control room.
6. Some strip charts will be eliminated.
7. The alarm panel will be replaced with the T&C Supervisors display. The ability to audio alarm any channel or composite in the system will be performed by the T&C Supervisors display.
8. The composite light panel will be replaced with the T&C Supervisors display. The ability to audio alarm any channel or composite in the system will be performed by the T&C Supervisors display.
9. Analog meters will be replaced with the T&C Supervisors display. The ability to audio alarm any channel or composite in the system will be performed by the T&C Supervisors display.
10. Parameter input directly into the VAX will not be provided for the users. Parameter input will be performed by using the TCOMs.
11. The T&C Monitor System will not be connected to the EMGNET, except for software development and maintenance. The normal operational mode will be for EMGNET to be disconnected.

12. Hardcopy equipment for TCOM's will be provided by the user and not T&C.

APPENDIX A
GLOSSARY OF TERMS

accelerated countdown

During the course of a normal countdown, the Test Director may manually speed up the step count in the command system.

ASE

Auxillary Systems Engineer

bypass equipment

Override alarm conditions. For example, for an analog channel, this would mean that if the channel reached an alarm limit, the alarm indicator would not be set. (text would not turn red)

calibration values

Values entered by the user at setup time which will be used to convert the data from volts to engineering units.

CCC Personnel

E.G.&G. personnel who are in the Command, Control, and Communications Department.

CP

Building CP-9 in area 6 at NTS.

coder clock

The timing portion of the command system.

command system

The system used to initiate commands to turn on and off various instruments and pieces of equipment in Forward Area during a countdown. It also sends the actual fire command which is responsible for detonating

the device.

contingencies

If one function drives one or more other functions where all functions are monitored, then the system will only alarm the source function if the source function is in the alarm condition rather than all associated functions.

Control Room

The room at building CP-9 which contains all user displays, analog meters, lamp alarms, strip charts and the command system.

countdown

The actual sequencing through of each command step within a predetermined time period, which is usually no longer than 60 minutes. Time is counted off in minutes and seconds.

data threshold

For a given channel, the user will specify a data threshold value. When the test is started, an initial scan will be taken and saved. A data scan will be taken immediately and compared to the previously saved value. If the absolute value of the difference between the current value and the previously saved value is greater than or equal to the specified data threshold value, then the new value will be saved. Otherwise, the current value will be ignored and a new scan will be taken. This process will be followed for all analog channels.

DCR

Diagnostics Compatibility Run (DCR). This is basically a FPFF that is invoked when there has been a deviation approved of the FPFF run. This is a mandatory run (all event site systems must participate, but there may be deviations if approved).

DSE

Device Systems Engineer

EPE

Electronics Project Engineer

FDR

	Final Dry Run (FDR). This is the last SDR performed and is a mandatory exercise.
Forward Area	The specific location at NTS for a given event which includes the trailer park
FPPF	Full Power Full Frequency (FPPF). This is a MSSR in shot configuration.
HDR	Hot Dry Run (HDR). This is a mandatory, special device systems run where participation of Device Systems, Prompt Diagnostics, and T&C is mandatory. The trailer park and ground zero are evacuated of all personnel for this run.
hold countdown	During the course of a countdown, the Test Director may choose to suspend the countdown process due to unforeseen problems in the Forward Area. This is called a hold condition.
ignore equipment	Monitor the channel but do not display any change in that channel to the user.
loss of lock	There is a decommutator in the Timing Station which converts a serial bit stream from the command system to parallel signals. If this decommutator gets out of synchronization, then this is call a loss of lock.
MSSR	Mandatory Simulated Signal Run (MSSR). This is an SDR with monitor data signals (real or simulated) present, from all participants on the event.
multiple alarm limits	More than one alarm limit for a given signal which occur at different times during a countdown.
NCP-12	A redundant monitor system for the Timing Station which is completely separate from the

current Varian system.

Script

This is a document prepared by CCC personnel based on the input given by all user for a given event. It lists by time and command step number which commands are to be sent to the Forward Area and what the T and C Monitor System will see as a result of the command.

SDR

Signal Dry Run (SDR). This is any dry run that originates in the control room at CP. Not all participants on the event are expected to go through this type of a test countdown.

step counter

Part of the command system used to denote sequence during a countdown.

TCOM

Timing and Control Operations Monitor, an LSI-11/23 based system which will reside in the Forward Area and will be a replacement of the current User/Encoders.

time dependencies

Given a particular user signal, there may be several periods of time during a countdown where the same state or level may take on different meanings, especially where alarm limits are concerned.

time threshold

For any given user signal, there may be a time threshold which means that if data has not been saved for that signal within a specified amount of time, then the current value for that signal will be saved.

Trailer Park

A cluster of user trailers at an event site which contain command, monitoring, and data acquisition equipment which will be used for conducting an event.

APPENDIX B
THE PROJECT TEAM

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Red Shack
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APPENDIX D

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