Functional Requirement Specification

RTCS DQ and RC Control Panel Replacement

December 10, 1992

1.0 Requirement

There is a requirement to replace the DQ and RC control panels on the existing RTCS with a single DQ control panel. The new DQ control panel will have a separate control computer system which will provide processing for the buttons, or simulated buttons. The new control system will communicate with the RTCS using RS 232 serial lines, and with associated IRIS graphics displays using the Version 1 Ethernet, Version 2 Ethernet, or IEEE 802.3 LAN. The purpose of this document is to identify the specific requirements for the new control computer system, and the requirements for any data gathering and graphics display systems which may interface with them.

2.0 Requirement Background

The existing control panels contain custom-made hardware which was provided by Datacom. They are therefore not easily maintainable. The processing for the control panel buttons is done by the RTCS Encore computer. Other radar and telemetry data processing computer systems are now available, and it is required to separate the RTCS into independent control, display, and data processing computer systems.

The most critical driver for replacement is the development of the IRIS displays and the eventual elimination of Aydin based displays. This elimination, starting with the RS console, generates the requirement of new and improved passive control functions on the DQ console which are divorced from the Encore processing. It is also desirable to simplify the controls, eliminate unused buttons, provide the ability to group display families, and allow for future changes to the console.

3.0 Groundrules and Assumptions

3.1 The communication between the control system and the graphics systems will be across the Ethernet/IEEE 802.3 LAN.

3.2 The communication between the control system and the data system will be across RS 232 serial lines. The control system will use the Ethernet data buffers which the data system broadcasts.

3.3 The user interface for the control system will be lightable buttons, or graphically simulated

buttons which are "pushed" with a mouse. Possible physical implementations of console "buttons" will be prototyped for assessment before a final decision is made as to how to implement them.

3.4 The messages such as telling the RTCS that a button has been pushed or telling a control system to light a button will be designed such that there will be no difference whether the user interface is physical or simulated buttons.

3.5 From this point on the term button will be used in describing the required functions with the understanding that the final product may be a simulated button.

3.6 Colors will be used to help distinguish between different functional states. Final color implementation will be specified in the design phase.

3.7 There will be six groups of displays controlled by the control system, the four DQ displays, and two passive RS displays.

3.8 The DQ displays will have both passive data and passive graphics control. The passive RS displays will have passive data control only.

3.9 There will be no point plot timing system controls. There will be no synch marks on plots. Plot type will be determined in the premission setup.

3.10 There will be no source ID control. The display systems will always display the data source color and symbol.

3.11 There will be no interval switch. The processing rate will be fixed in the premission setup.

3.12 The term plasma will be used to describe a display similar to the current plasma display. The actual implementation may be on a CRT.

3.13 To allow for multiple missions, there will be two of the following buttons or lights: TIME INIT, MISSION START, RECORD RAW, RECORD PROC, MA FIL INIT, MA PWRD FLT, BEST, NBST, SYSTEM MODE, COUNTDOWN,and LIFTOFF.

3.14 If only one mission is loaded, only one set of the multiple mission buttons will be lit and respond to being pushed.

3.15 Except for PANEL TEST and intensity controls, none of the buttons will respond to being pressed until the RTSP READY light is lit green.

4.0 Function

The functions will be defined in terms of what buttons will be required, what they will do, and what messages they will require to be sent or received. In general, the control system will send messages indicating that a button has been pushed, and it will receive messages to light buttons.

4.1 Protected Buttons

These buttons will require special processing to prevent their accidental use.

4.1.1 RECORD RAW (2)

This button will light white if raw data recording is enabled in the premission setup. If not enabled in the premission setup, it is not lit and will not respond to being pushed. This will require a message from the data system to light white if raw data recording will be active.

When the data system starts recording raw data, usually based on a time value in the premission setup, it will light green. This will require a message from the data system to light green.

If pushed when white, the data system will start raw data recording, and it will light green. This will require a message to the data system to begin recording raw data, and a return message to light green.

If pushed when green, the data system will stop recording raw data, and it will light white. This will require a message to the data system to stop recording raw data, and a return message to light white. Raw data recording can be restarted and stopped as many times as desired.

4.1.2 RECORD PROC (2)

This button will light white if processed data recording is enabled in the premission setup. If not enabled in the premission setup, it is not lit and will not respond to being pushed. This will require a message from the data system to light white if processed data recording will be active.

When the data system starts recording processed data, usually based on a time value in the premission setup, it will light green. This will require a message from the data system to light green.

If pushed when white, the data system will start processed data recording. This will require a message to the data system to begin processed data recording, and a return message to light green.

If pushed when green, the data system stops recording processed data, and it will light white. This will require a message to the data system to stop recording processed data, and a return message to light white. Processed data recording can be restarted and stopped as many times as desired.

4.1.3 MISSION START (2)

This button will indicate that the mission has started and the data system is processing data. It will light white when a mission is loaded. This will require a message from the data system to light white.

When the data system starts processing data, usually based on a time value in the premission setup, it will light green. This will require a message from the data system to light green.

If pushed when white, the data system will start processing data, and it will light green. This will require a message to the data system to start processing, and a return message to light green.

If pushed when green, the data system will stop processing, and it will light red. Data processing will only be restarted by reloading the mission. This will require a message to the data system to stop processing, and a return message to light red.

4.2 Indicator Lights

These lights are indicators only and will not respond to being pushed.

4.2.1 RTSP READY

This indicator will light green when the data system is ready. If it is not lit, none of the other buttons will respond to being pushed. This will require a message from the data system that it is ready and to light green. Processing for the other buttons and lights will not begin until this message has been received.

4.2.2 GRAPHICS READY

This indicator will light green when the graphics system is ready. This will require a message from the graphics system that it is ready and to light green.

4.2.3 SYSTEM MODE (2)

This indicator will consist of a display title which will light green when a mission is live. It will light red when in simulation mode. This will require a message from the data system at load time to light either green or red, depending on the type mission, and telling the title to display.

4.2.4 SOFTWARE TEST

This indicator will consist of a display title which will light green when officially released software is loaded. It will light red when test modules are loaded. This will require a message from the data system at load time to light either green or red, depending on the type of load modules, and telling the title to display.

4.2.5 NO PANEL INPUT

This indicator will light green when the data system is active. It will blink if the data system drops out. This will require timer messages from a "heartbeat" program on the control system and system active messages from the data system.

4.2.6 NO GRAPHICS INPUT

This indicator will light green when the graphics systems are active. It will blink if the graphics systems drop out. This will require timer messages from a "heartbeat" program on the control system and system active messages from the master display system.

4.2.7 GMT

This indicator will display GMT. A NASA36 time card will be included in the control system.

4.2.8 COUNTDOWN (2)

This indicator will display the mission countdown time. Time boards for countdown time will be included in the control system.

4.2.9 LIFTOFF (2)

This indicator will display the time when liftoff is detected. Liftoff detection hardware will be included in the control system. A message will be sent to the data system when liftoff is detected.

4.2.10 MESSAGES

This indicator will consist of error message or data message texts. Messages may be sent by the data system, display system, or be generated internally by the control system. If space allows a scrolling area will be reserved for the message display.

4.3 OUPUT RELAYS

There will be 8 pairs of arm switches and fire buttons connected to actual physical relays which will be premission controllable.

4.3.1 ARM

The arm switches will be mechanical and will only be manually armed. If a relay circuit is not armed there will be not be a physically complete circuit, so no fire commands will be able to pass through.

4.3.2 FIRE

The fire buttons will work with the corresponding output relay circuit arm switches. If a relay is enabled in the premission setup, the corresponding fire button will light to indicate whether it is software controlled, manually controlled, or both. This will require a message from the data system telling it how to light.

If a fire button will accept manual control, it will respond when pushed. This will require a message to the data system that it was pushed, and a return message telling it how to light in response. It will also require a fire signal to be sent to the relay telling it what state it should be.

If a fire button is software controlled, it will light to indicate that it has been software activated.

This will require a message to be sent from the data system telling it how to light. It will also require a fire signal to be sent to the relay telling it what state it should be.

If a relay circuit was not armed when a fire signal was sent, then a fire signal will be sent whenever the relay is armed. A timeout feature will be provided so that a fire signal can be cleared from an unarmed circuit.

A fire button will also display the state of its relay such as open/closed. This will require the ability to sense the state of the relay, and a signal from the relay whenever its state changes.

4.4 Function Control

These buttons will control both fixed and software defined functions.

4.4.1 TIME INIT (2)

This button will be used to reset program time to zero and to reinitialize filters and other system functions. It will light white when the RTSP READY indicator light comes on. This will use the same message as the RTSP READY light from the data system to light white.

If pushed when white, it will tell the data system to reset time and reinitialize, and it will light green. This will require a message to the data system to reinitialize and a return message to light green.

When the data system has finished its reset, the light will go white. This will require a message from the data system to light white.

4.4.2 Software Definable Functions

These 16 buttons will be used for software definable functions. If one of the buttons has been defined in software, it will light up with a function designator. This will require a message from the data system telling it how to light.

If one of these buttons is pushed when lit, a message will be sent to the data system indicating that it has been pushed. The data system will send a return message telling it what to light in response. If it is pushed again, it will send a message to the data system and again receive a response telling it how to light.

4.5 GRAPHICS CONTROL

These buttons will be used to determine which data sources will be displayed and to provide passive graphics control.

4.5.1 Data Selection

This bank of 6 x X+4 buttons will be used to determine which of the X data sources, best, and

next best source should be displayed on all viewport coordinate systems of a display group. There will be 6 sets of buttons, one for each display group. Each set will be labelled SRC1, SRC2, . . . SRCX, BEST(2), NBST(2).

Data source order will be determined in the premission setup, by data routing control on the Radar Status/Control panel, or at the modem patch panel. The data source name will appear on the button. This will require a message from the data system telling the names to display on the data source buttons.

For each display group, buttons in one set will control the data sources for all displays in the associated display group. Before any sources have been selected, the available data sources and/or best, next best will light white. Up to N of the available data sources may be selected, including best and next best as possible sources. This will require a message from the data system telling which sources are available.

If a button is pushed when white, it will light green if fewer than N source buttons are green. The selected source will be added to the displays in the group. This will require a message to the display systems to add the source to the display if it is receiving it, and a return message to light green. If a button is pushed when it is white, and N source buttons are green, it will be ignored. If any button is pushed when not lit, it is ignored.

If a button is pushed when green, it will go back to white, and the selected source will be removed from the displays in the group. This will require a message to the display systems to stop displaying the data source, and a return message to light white.

4.5.2 Display control

This bank of 4 x 5 buttons will provide display control for the 4 DQ display groups.

4.5.2.1 ALPHA FREEZE

This button in each group will be used to freeze the alphanumerics on the associated displays so that hard copies can be made. It will come up off. If pushed it will light green. This will require a message to the display systems to stop updating, and a return message to light green.

If pushed when green, the displays will begin updating, and the light will go off. This will require a message to the display systems to begin updating, and a return message to turn off the light.

4.5.2.2 MANUAL UP

This button in each group will be used to control manual scaling for the associated displays. It will come up off. If pushed it will light green, automatic scaling will be disabled, and subsequent pushes of the corresponding VP buttons will cause the scale to move up to the next predefined scale. This will require a message to the graphics system to disable automatic scaling, and a return message to light green.

If pushed when green, automatic scaling will be enabled and manual scaling terminated. This will require a message to the graphics system to return to automatic scaling, and a return message to

turn the light off.

If it is green and MANUAL DOWN is pushed, the light will turn off.

If pushed when MANUAL DOWN is green, manual scaling will remain enabled, and subsequent pushes of corresponding VP buttons will cause the scale to move up to the next predefined scale. This will require no additional messages.

4.5.2.3 MANUAL DOWN

This button in each group will be used to control manual scaling for the associated displays. It will come up off. If pushed it will light green, automatic scaling will be disabled, and subsequent pushes of the corresponding VP buttons will cause the scale to move down to the next predefined scale. This will require a message to the graphics system to disable automatic scaling, and a return message to light green.

If pushed when green, automatic scaling will be enabled and manual scaling terminated. This will require a message to the graphics system to return to automatic scaling, and a return message to turn the light off.

If it is green and MANUAL UP is pushed, the light will turn off.

If pushed when MANUAL UP is green, manual scaling will remain enabled, and subsequent pushes of corresponding VP buttons will cause the scale to move down to the next predefined scale. This will require no additional messages.

4.5.2.4 VP1 SCALE

This button in each group will display the scale number for viewport 1 of coordinate system 1. This will require a message from the graphics system whenever a scale is set or changed.

If pushed when MANUAL UP is green, the scale for viewport 1 of coordinate system 1 will move up to the next predefined scale. This will require a message to the graphics system to move up to the next predefined scale.

If pushed when MANUAL DOWN is green, the scale for viewport 1 of coordinate system 1 will move down to the next predefined scale. This will require a message to the graphics system to move down to the next predefined scale.

4.5.2.5 VP2 SCALE

This button in each group will display the scale number for viewport 2 of coordinate system 1. This will require a message from the graphics system whenever a scale is set or changed.

If pushed when MANUAL UP is green, the scale for viewport 2 of coordinate system 1 will move up to the next predefined scale. This will require a message to the graphics system to move up to the next predefined scale.

If pushed when MANUAL DOWN is green, the scale for viewport 2 of coordinate system 1 will move down to the next predefined scale. This will require a message to the graphics system to move down to the next predefined scale.

4.6 Data Control

This 5 by X bank of buttons will have five functions repeated for each of the X possible data sources.

4.6.1 DATA CAP

The data capture buttons will control which data sources will be captured and therefore available for processing and recording on tape or disk by the RTSP. Buttons for sources selected in the premission setup will light green when the system starts. The others will be off. This will require a message from the data system telling which source buttons to light green.

If pushed when green, a button will light white and data from that source will no longer be available to the RTSP. This will require a message to the data system that the source is no longer available, and a return message to light white.

If pushed when white, a button will light green and that data source will be available to the RTSP. This will require a message to the data system that the data source is available, and a return message to light green.

If an unlit button is pushed, it will light green and that data source will be available for processing whether it actually has any data or not. It will then work like any source button that was lit by the premission setup.

4.6.2 DATA PROC

The data processing buttons will control which data sources will be processed. The maximum number of sources which can be processed, up to N, will be determined by the premission setup. Sources selected for processing in the premission setup will light green when the system starts. Available sources which were not selected by the premission setup will light white. The others will be off. This will require a message from the data system telling which sources to light green and which ones to light white.

If the maximum number of sources is lit green, all pushes on non-green buttons will be ignored. One of the sources must be taken out of processing before another one can be put in. If a button is pushed when green, processing for that data source will stop, and the button will light white. This will require a message to the data system to stop processing that source, and a return message to light white. If the source had been chosen for consideration for best select, the best select light for that source will go off. This will require an additional message from the data system to turn the corresponding best select light off.

If a white available source button is pushed, and the maximum number of sources is not being processed, the light will go green and the processing will start for the data source. This will require a message to the data system to start processing the data source, and a return message to

light green.

If a light is green, and data for that source drops out, the light will blink until data processing is resumed. This will require timer messages from a "heartbeat" program on the control system, and will use the data messages from the data system.

4.6.3 BEST SEL

The best select buttons will light green for all sources being processed as defined by the premission setup. This will require a message from the data system telling which buttons to light green.

When a green button is pushed, it will light red and will not be considered in the best select algorithm. This will require a message to the data system to remove the data source from consideration for best select, and a return message to light red.

If a red button is pushed, it will light green and once again be considered in the best select algorithm. This will require a message to the data system to add the data source for consideration for best select, and a return message to light green.

Any pushes of unlit buttons are ignored. The buttons may be lit red automatically when a source is removed from processing as described in the previous section.

4.6.4 FIL INIT

The filter initialization buttons will come up white for all data sources being processed. This will require a message from the data system telling which buttons to light white.

If a data source is removed from processing, its associated filter initialization button will go off. This will require a message from the data system to go off.

If a white button is pushed, it will light green and the filter for that data source will be reinitialized. As soon as the initialization is complete, the light will go back to white. Since it will occur within 70 ms, the light will appear to make one blink green. This will require a message to the data system to initialize the filter for the data source, and a return message to light green. It will require another message from the data system to light white when the initialization is complete.

4.6.5 PWRD FLT

The powered flight filter buttons will come up green for all data sources which are being processed. If a green button is pushed, it will go white and the filter for that data source will be changed to coast. This will require a message to the data system to change the filter to coast, and a return message to light white.

If a white button is pushed, the light will go green and the filter for that data source will be changed from coast to powered flight. This will require a message to the data system to change

the filter to powered flight, and a return message to light green.

4.6.6 MA FIL INIT (2)

The master filter initialization button will be protected to prevent accidental use. It will come up white and blink green once when pushed. It will have the same effect as simultaneously pushing all lit FIL INIT buttons, and will require the same messages.

4.6.7 MA PWRD FLT (2)

The master powered flight filter button will be protected to prevent accidental use. It will come up white and blink green once when pushed. It will have the same effect as simultaneously pushing all white PWRD FLT buttons and will require the same messages.

4.7 Panel Control

These buttons are used to control features of the panel and displays.

4.7.1 PANEL TEST

When this button is pushed, the buttons and lights on both the Graphics Control and the Radar Status Control panels will begin to light on and off through their available colors according to a predefined sequence. The sequence will continue and repeat until the button is pushed again. This will not require any external messages. The function will be available in real-time, and the button will be placed in an out of the way location.

4.7.2 DIMMER

This button will indicate if the button, graphics, or panel intensity will be dimmer or brighter when changed. It will come up indicating brighter. When pushed it will change to dimmer. If pushed when dimmer, it will toggle back to brighter. This will require no external messages.

4.7.3 BUTTONS

This button will indicate the intensity level of the button lights. This will require an internal message telling the button intensity level any time it is changed. If pushed when DIMMER indicates dimmer, the intensity level will be lowered. If pushed when DIMMER indicates brighter, the intensity level will be increased. This will require no external messages.

4.7.4 GRAPHS

This button will indicate the intensity level of the graphics displays. This will require a message from the display system telling the graphics intensity level any time it is changed.

If pushed when DIMMER indicates dimmer, the intensity level will be lowered. This will require a message to the display system telling it to lower the intensity of the displays.

If pushed when DIMMER indicates brighter, the intensity level will be increased. This will require a message to the display system telling it to increase the intensity of the displays.

4.7.5 PANEL

This button will indicate the intensity level of the panel displays. This will require an internal message telling the panel intensity level any time it is changed. If pushed when DIMMER indicates dimmer, the intensity level will be lowered. If pushed when DIMMER indicates brighter, the intensity level will be increased. This will require no external messages.

4.7.6 MSG LOG

This button will control whether or not messages will be displayed on the control panel and logged to disk. It will come up with message logging enabled. If pushed when message logging is enabled, it will be disabled. If pushed when message logging is disabled, message logging will be enabled. It will require no external messages.

4.8 Indicator Lights and LED Buttons

This 3 by X+2 bank of lights/buttons will show 3 functions for each of the X possible radar data sources and the two transmit sources.

4.8.1 SYNC ERROR

A button in this column will come up showing a sync error count of zero and will blink red each time a sync error occurs for its corresponding data source. Each time it flashes, the sync error count will be incremented by one, up to 999. This will require a message from the data system to flash red, and to increment the sync error count.

If pushed, the sync error count will go back to zero.

4.8.2 DATA ERROR

A button in this column will come up will a count of zero data errors and will blink red each time a data error, as indicated by a bad CRC value, occurs for its corresponding data source. Each time it flashes, the data error count will be incremented by one, up to 99. This will require a message from the data system to flash red and to increment the data error count.

If pushed, the data error count will go back to zero.

4.8.3 LOCK

The lights in this column are indicators only. If data is sync locked for the associated radar data source, the light will be green. This will require a message from the data system to light green upon sync lock of data.

If sync is lost for the data source, the light goes off. This will require a message from the data

system to turn off.

4.10 Plasma Display

The plasma display panel will have 14 fields for each of the X possible radar data sources and two transmit sources. It will be used for display only and have no buttons or switches. Contents of the fields will determined by the data system, and will require messages each time the data updates.

4.9.1 QS

The quality status field will contain a number from 0 to 9, where 9 is the highest, as determined by an algorithm in the data system.

4.9.2 DIS

The display field will contain the letter D if data from the radar is being displayed, or be blank if it is not being displayed.

4.9.3 E/X

The edit/extrapolate field will flash the letter E if editing is being done by the data system. It will flash the letter X if an extrapolation is done by the data system. The rest of the time it will be blank.

4.9.4 DATA QUALITY

This field will be BEST, NBST, BEST2, NBST2 or blank depending on whether the radar has been selected best, next best, or neither by the data system best select algorithm.

4.9.5 DATA TYPE

This field will be RAW, SMO, or blank depending on whether the data is raw, being smoothed, or neither. If a data source is being processed, it will be smoothed.

4.9.6 SITE ID

This field will contain the raw sight ID.

4.9.7 SITE NAME

This field will contain the acronym for the name of the sight. Some examples would be R3, MATS, or TM. Laser data from a source will have a distinctive sight name.

4.9.8 RNG

This field will contain the range.

4.9.9 AZ

This field will contain the azimuth.

4.9.10 EL

This field will contain the elevation.

4.9.11 Q

This field will display the quality bit.

4.9.12 T

This field will display the track bit.

4.9.13 TIME

This field will display the data time.

4.9.14 MODE

The mode of each data source will be displayed as MAN, AUTO, ACQU, or N/A depending on whether the radar mode as decoded from the mode bits is manual, autotrack, acquisition or not available.