From-To list

for

MARES-0000-SP-103-NTE

HRF Interface Specification

Revised: 12/12/02

ADD:
HRF to the signature Page

ADD:
LIST OF ACRONYMS

CHIP	Common Hardware Implementation Plan
FTP	File Transfer Protocol
GFS	Government Furnished Software
IP	Internet Protocol
HRD	Hardware Requirements Document
PC	Portable Computer
PCS	Portable Computer System
SOEP	Science and Operations Evaluation Plan

FROM:
1.1 Purpose
The purpose of this Document is to define the MARES interfaces with HRF human research facility.
TO:
1.1 Purpose
The purpose of this Document is to define the MARES interfaces with the ~~HRF human~~ Human ~~research~~ Research ~~facility~~Facility (HRF).

FROM:
1.2 Scope
The specifications established herein are applicable only to the MARES. This document defines the external interfaces in the section three and the internal ones in the section four.
TO:
1.2 Scope
The specifications established herein are applicable ~~only~~ to ~~the~~ MARES and the HRF hardware that interfaces to MARES. This document defines the external interfaces in ~~the~~ section three and the internal ones in ~~the~~ section four.

FROM:
1.3 Muscle Atrophy Research and Exercise System (MARES)

MARES is a physiological research facility, part of the HRF, to be used on board ISS.

MARES will be used to carry out research on muscle-skeletal, biomechanical, neuromuscular and neurological physiology, to study the effect of microgravity on the human being, and to evaluate the effect of the countermeasures to the Space environment induced physiological effects.

MARES can also be used to evaluate the performance of exercise tests protocols.

The MARES hardware is aisle mounted hardware, capable of assessing the strength of isolated muscle groups, around specific joints or on complete limbs, by measuring and controlling the interrelation between speed and torque/force, as functions of time.

The principal components of MARES shall be: main assembly consisting of main box and vibration isolation frame, chair, human interface adapters, launch structure assembly and a laptop computer for interaction with the crew. MARES shall also include the associated cables to connect the various MARES components together, to the ISS and to HRF.

During launch and landing, the MARES elements will either be mounted on the Launch Structure Assembly (LSA) or stowed in launch containers. During on-orbit operations, MARES will be deployed in the aisle. When not used on-orbit MARES will be stowed.

The MARES facility will be launched in different packages for easy launch accommodation. Once in orbit MARES will have to be assembled.

The Main Assembly for MARES will consist of the Main Box and the Vibration Isolation Frame.

The MARES Main Box will contain a motor, controller, power electronics, supervision electronics, battery, set of harnesses devoted to subsystems interconnection, heat rejection systems and angular motion and torque sensors.

TO:
1.3 Muscle Atrophy Research and Exercise System (MARES)

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1.3.1 MARES Components
The principal components of MARES shall be: main assembly consisting of main box and V~~v~~ibration I~~i~~solation F~~f~~rame (VIF), chair, human interface adapters, L~~l~~aunch S~~s~~tructure A~~a~~ssembly and a laptop computer for interaction with the crew. MARES shall also include the associated cables to connect the various MARES components together, to the ISS and to HRF.

During launch and landing, the MARES elements will either be mounted on the Launch Structure Assembly (LSA) or stowed in launch containers. During on-orbit operations, MARES will be deployed in the aisle. When not used on-orbit MARES will be stowed.

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1.3.2 MARES Main Box
The MARES Main Box will contain a motor, controller, power electronics, supervision electronics, battery, set of harnesses devoted to subsystems interconnection, heat rejection systems, and angular motion and torque sensors.

1.3.3 Vibration Isolation Frame (VIF)
The purpose of the Vibration Isolation Frame is to avoid the perturbation of the microgravity environment of ISS while MARES is in use. At the same time, it keeps MARES in its correct position, and limits the range of displacement of the equipment. The VIF and MARES Main Box can be easily and quickly separated for stowage.

FROM:
2.1 SPECIFICATIONS

SSP-30245	rev. B	Space Station Electrical Bonding Requirements
SSP 30512C	rev. C	Space Station Ionizing Radiation Design Environment
SSP 57000	Rev. A 2 Feb. 98	Pressurized Payloads Interface Requirements Document
SSP 50018	28 June 96	International Space Station (ISS) Standard Stowage Accommodations Handbook

TO:
2.1 SPECIFICATIONS

~~SSP 30245~~	~~rev. B~~	~~Space Station Electrical Bonding Requirements~~
~~SSP 30512C~~	~~rev. C~~	~~Space Station Ionizing Radiation Design Environment~~
SSP 57000	Rev. ~~A~~ E ~~2 Feb. 98~~1 Nov 2000	Pressurized Payloads Interface Requirements Document
SSP~~50018~~ 57020	~~28 June 96~~ Rev A 6 Jun 2002	~~International Space Station (ISS) Standard Stowage Accommodations Handbook~~ Pressurized Payload Accommodation Handbook
SSP 41017	Rev H 18 May 2001	Rack to Mini Pressurized Logistics Module (MPLM) Interface Control Document (ICD) Part 2

FROM:
2.2 STANDARDS

JHB-8080.5	.5	JSC Design and Procedural Standards Manual
SSP 50005 B	Aug. 95	International Space Station Flight Crew Integration

TO:
2.2 STANDARDS

~~JHB-8080.5~~	~~.5~~	~~JSC Design and Procedural Standards Manual~~
~~SSP 50005 B~~	~~Aug. 95~~	~~International Space Station Flight Crew Integration~~

FROM:
2.3 PUBLICATIONS

GPQ-010	Issue 1, Revision 0	Product assurance requirements for ESA microgravity projects. + Change Not. 01
GPQ-010-PSA-101	Issue 1, Revision 0	Safety and materials requirements for ESA microgravity payloads (ISSA)
GPQ-010-PSA-102	Issue 1, Revision 0	Reliability and maintainability for ESA microgravity facilities (ISSA) + Change Not. 01
LS-71053-1	Issue 2, Revision 3, August, 1998	Hardware Requirements Document (HRD) For the Muscle Atrophy Research And Exercise System (MARES) Of The Human Research Facility (HRF)
LS-71001	rev. A Nov. 25, 1996	Functional Requirements Document for the Human Research Facility
MARES-SP-007-03-NTE	31.07.97	MARES Payload Software Specification
MAR-701-ESA/AK	4.D 23 March 1998	Science and Operations Evaluation Plan (SOEP)
PIRN 57000-NA-066B to SSP 57000	03/4/98	Fire Detection and Suppression Requirements
LS-40104	April 30, 1997	Neurolab Experiment, SRD for E049, E095, and E294. Studies of the Autonomic Nervous System.
LS-40105	May 28, 1997	Neurolab Experiments, SDD.

TO:
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LS-40104	April 30, 1997	Neurolab Experiment, SRD for E049, E095, and E294. Studies of the Autonomic Nervous System.
LS-40105	May 28, 1997	Neurolab Experiments, SDD.

FROM:
2.5 Reference documents

LS-71098	April 1997	Common Hardware Implementation Plan (Chip) For the Human Research Facility
SSP 30242	03/06/94 Revision C	Space Station Cable/Wire Design Requirements for Electromagnetic Compatibility

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2.5 Reference documents

LS-71098	April 1997	Common Hardware Implementation Plan (Chip) For the Human Research Facility
SSP 30242	~~03/06/94~~22 Dec 1998 Revision ~~C~~E	Space Station Cable/Wire Design Requirements for Electromagnetic Compatibility

FROM:

3.1 Interfaces definition

MARES interfaces either with, HRF Workstation or second HRF Portable Computer for data communications, external instrumentation like Physiological conditioner (PSC), and Percutaneous Electrical Muscle Stimulator (PEMS) for data acquisition and control.

Furthermore MARES will have a test connector for calibration and troubleshooting purposes.

MARES HRF interfaces definition matrix

	MARES			
	Mechanical i/f	Electrical i/f	Thermal i/f	Comd&DH i/f
HRF Removable Hard Disck	MARES-HD-M			
HRF Work Station				MARES-WS-SW
MARES HRF Portable Computer		MARES-PC-E		MARES-PC-SW
External Devices		MARES-ExD-E		MARES-ExD-SW
HRF Common Hardware		MARES-Test-E		
M: mechanical interface E: Electrical interface TH: thermal interface SW: Command and data handling interface				

TO:

3.1 Interface~~s definition~~ Definition

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~~Furthermore MARES will have a test connector for calibration and troubleshooting purposes.~~
The interfaces to MARES are shown in Table 3-1 and in Figure 3-1. Detailed descriptions of each interface are provided in the following subsections.

Table 3-1. MARES/HRF Interfaces Definition Matrix

	Mechanical I/F	Electrical I/F	Thermal I/F	C&DH I/F
HRF Removable Hard DiskMARES VIF Interface	MARES-HD-M MARES-VIF-M			
HRF VIF Interface	VIF-HRF-M			
HRF MARES Interface	MARES-HRF-M			
MARES Launch Interface	MARES-LSA-M			
HRF Works Station	MARES-HD-M			MARES-WS-SW
MARES HRF Portable Computer		MARES-PC-E		MARES-PC-SW
External Devices		MARES-ExD-E		MARES-ExD-SW
HRF Common Hardware		MARES-Test-E		
HRF Power Interface Panel		MARES-UIP-E		
Columbus APM		MARES-UOP-E	MARES-COL-TH	

M: mechanical interface
E: Electrical interface
TH: thermal interface
SW: Command and Data Hhandling interface

(ADD:)

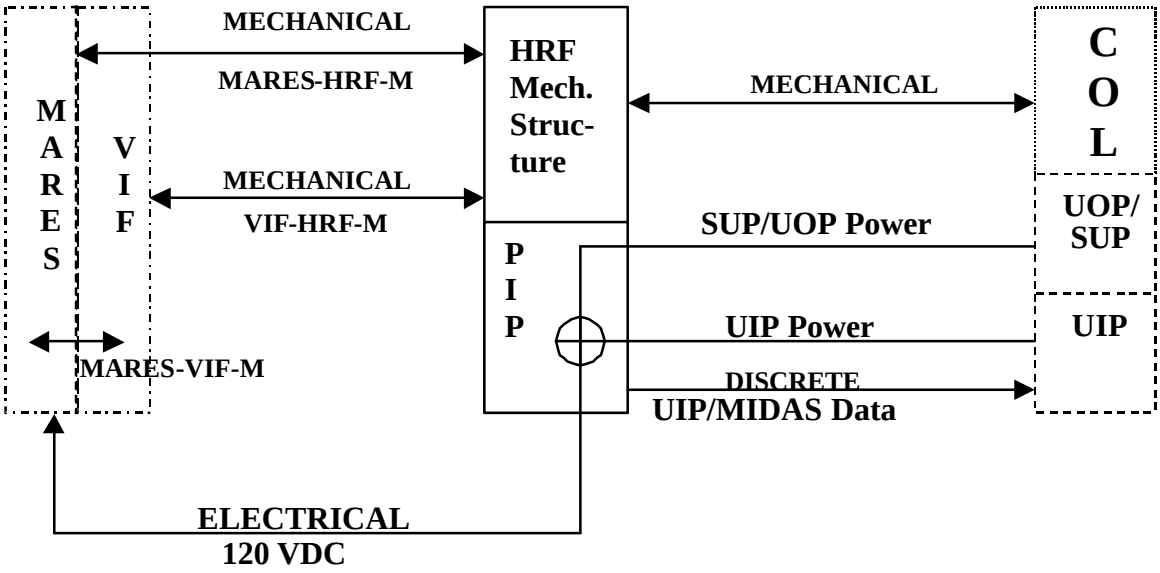

Figure 3-1. MARES Mechanical and Electrical Interfaces

FROM:
3.2.1.1 MARES to HRF removable Hard Disk interface (MARES-HD-M)
Through this interface MARES will be able to interchange files with the HRF workstation by the procedure of carry the Hard Disk from MARES to HRF workstation and viceversa.

HRFIS 3.2.1.1.1.1.1.10
MARES shall be able to accommodate two HRF removable Hard Disks being compatible with the interface defined in the NASA drawing 'SDG46115663'.

TO:
3.2.1.1 MARES to HRF Rremovable Hard Disk Iinterface (MARES-HD-M)
Through this interface MARES will be able to interchange files with the HRF Wworkstation by the procedure of carrying the Hard Disk from MARES to the HRF Wworkstation and vice versa.

HRFIS 3.2.1.1.1.1.1.10
MARES shall be able to accommodate two HRF removable Hard Disks being compatible with the interface defined in the NASA drawing 'SDG46115663'.

FROM:
3.2.1.2 MARES conector pannel
MARES shall have a so called Conector Pannel grouping

- All the external connectos
- 4 leds indicating the MARES status.
- The MARES ON/OFF pushbuttons
- Two circuit breakers. That protects the External Devices and MARES PCS power suplies outputs
- Two fuses holders. One with the fuse that protects the MARES interface with the ISS power bus and another carring a spare fuse.

TO:
3.2.1.2 MARES Cconnector Mating Ppannel (CMP)
MARES shall have a so called Connector Mating Pannel grouping

- All the external connectors
- 4 leds LEDs indicating the MARES status.
- The MARES ON/OFF pushbuttons
- Two circuit breakers. tThat protects the External Devices and MARES PCS power supplies outputs
- Two fuses holders. One with the fuse that protects the MARES interface with the ISS power bus and another carrying a spare fuse.

FROM:
HRFIS 3.2.1.2.1.1.1.10
This CMP shall be placed in the right (front view) lateral pannel of the MARES main box and shall have the following distribution:

<<< figure; no change >>>

TO:
HRFIS 3.2.1.2.1.1.1.10
This CMP shall be placed in the right (front view) lateral pannel of the MARES main box and shall have the following distribution: shown in Figure 3-2.

<<< figure; no change >>>
Figure 3-2. Connector Mating Panel (CMP) Layout

ADD:
3.2.1.3 MARES to VIF Mechanical Interface (MARES-VIF-M)

MARES shall be easily detached from the VIF using the following interface:
<<< insert MARES to VIF interface specs, figures, tables, etc. here (to be provided by ESA/NTE)>>>

3.2.1.4 VIF to HRF Mechanical Interface (VIF-HRF-M

The VIF shall be attached to the HRF mechanical seat-track structure using the seat track interface specified in SSP 41017.

3.2.1.5 MARES to HRF Mechanical Interface (MARES-HRF-M)

HRF will be able to mechanically interface to the MARES using the MARES-VIF-M interface. HRF will utilize the accommodations on the main box that are used by the VIF quick-disconnect system to facilitate stowage.

3.2.1.6 MARES to Launch Interface (MARES-LSA-M)

MARES shall be able to be attached, for launch, to a structure or placed in soft stowage.

FROM:
3.2.2.1 MARES to HRF Portable Computer Electrical Power Interface (MARES-PC-E)

Although this is an internal interface due the fact that this Portable Computer will be provided by HRF its electrical characteristics are included in this document

Through this interface the MARES HRF Portable Computer will be powered from the MARES main box.
<<< figure; no change >>>

TO:
3.2.2.1 MARES to HRF Portable Computer Electrical Power Interface (MARES-PC-E)

~~Although this is an internal interface due the fact that this Portable Computer will be provided by HRF its electrical characteristics are included in this document~~

Through this interface the MARES HRF Portable Computer will be powered from the MARES main box, as shown in Figure 3-3..
<<< figure; no change >>>
Figure 3-3. MARES to HRF PC Power Interface

FROM:
HRFIS 3.2.2.1.1.1.10
HRF will provide the following external cables:
· SEG46115568 defined as HRF common hardware in LS-71098 Document
· SEG46115488, SEG46115488 defined in Interface Definition Document For The Human Research Facility Portable Computer.

TO:
HRFIS 3.2.2.1.1.1.10
HRF ~~will~~ shall provide the following external cables:
· SEG46115568 defined ~~as HRF common hardware~~ in LS-71098 ~~Document~~ Common Hardware Implementation Plan (CHIP) for the HRF
· SEG46115488, SEG46115488 defined in LS-71046-1, Interface Definition Document For The Human Research Facility Portable Computer.

FROM:
Table 3.2-1 Portable computer power interface
Voltage: 28±0.5

TO:
Table 3.2-1 Portable Ccomputer Ppower Iinterface
Voltage: 28±0.51

FROM:
3.2.2.2 MARES to External Devices Electrical Power Interface (MARES-ExD-E)
MARES will provide power supply for external instrumentation like Physiological conditioner (PSC), and Percutaneous Electrical Muscle Stimulator (PEMS).

TO:
3.2.2.2 MARES to External Devices Electrical Power Interface (MARES-ExD-E)
MARES will provide power supply for external instrumentation like Physiological conditioner (PSC), and Percutaneous Electrical Muscle Stimulator (PEMS).

FROM:
HRFIS 3.2.2.2.1.1.1.10
MARES shall provide power supply to external devices through the connector defined in Table 3.2-2

Table 3.2-2 External device power supply connector
Voltage: 28±0.5

HRFIS 3.2.2.2.1.1.1.20
MARES External Device Power supply shall be in accordance with the defined in HRFIS 3.2.2.1.1.1.1.10 to 90

TO:
HRFIS 3.2.2.2.1.1.1.10
MARES shall provide power supply to external devices through the connector interface defined in Table 3.2-2.

Table 3.2-2 External Ddevice Ppower supply Interfaceconnector
Voltage: 28±0.51

HRFIS 3.2.2.2.1.1.1.20
MARES External Device Power supply shall be in accordance with the defined requirements in HRFIS 3.2.2.1.1.1.1.10 20 to 90.

FROM:
3.2.2.3 MARES-Test-E
In order to acces to these connectors it shall be necessary to remove the MARES back cober.

TO:
3.2.2.3 MARES-Test-E
In order to accesaccess to these connectors it shall be necessary to remove the MARES back cobercover.

FROM:
HRFIS 3.2.2.3.1.1.1.50
Serial lines compatibles with the HRF PCS, ComCard232/422/485/2 PCMCIA card connector

TO:
HRFIS 3.2.2.3.1.1.1.50
Serial lines show below shall be compatible~~s~~ with the HRF PC~~S~~, ComCard232/422/485/2 PCMCIA card connector.

FROM:
3.2.3.1 MARES to HRF Portable Computer Command and Data Handling Interface (MARES-PC-SW)

Although this is an internal interface due the fact that this Portable Computer will be provided by HRF it is included in this document

Through this interface MARES Main box will establish communication with MARES HRF Portable Computer over
<<< figure >>>
an Ethernet link.

HRFIS 3.2.3.1.1.1.1.10
MARES shall provide Ethernet connection for the Portable Computer through the next defined connector (MARES-PCETH)

TO:
3.2.3.1 MARES to HRF Portable Computer Command and Data Handling Interface (MARES-PC-SW)

~~Although this is an internal interface due the fact that this Portable Computer will be provided by HRF it is included in this document~~

Through this interface the MARES Main box will establish communication with ~~MARES~~ HRF Portable Computer over an Ethernet link.

<<< figure >>>

HRFIS 3.2.3.1.1.1.1.10
MARES shall provide an Ethernet connection for the Portable Computer ~~through the next~~as defined ~~connector~~ in Table 3.2-3. ~~(MARES-PCETH)~~

FROM:
3.2.3.2 MARES to Human Research Facility Rack Command and Data Handling Interface (MARES-HRF-SW)

This interface shall consist on a connector on the MARES connector panel plus a cable able to connect MARES to the HRF WS connector.

Although the MARES external interface consist only in the MARES-HRFETH connector all the harness definition is included

TO:
3.2.3.2 MARES to ~~Human Research Facility Rack~~Workstation Command and Data Handling Interface (MARES-~~HRF~~WS-SW)

This interface shall consist on a connector on the MARES connector panel plus a cable ~~able~~ to connect MARES to the HRF WS connector.

Although the MARES external interface consist only in the MARES-HRFETH connector all the harness definition is included.

FROM:
HRFIS 3.2.3.2.1.1.1.20
The data to be transferred may be grouped in the following two categories:

- Files transferring: That includes MARES software updating, up-loading of experiments and down-loading of experiments executions related data.
- On line data transferring: real time transmission of experiment execution related data for down-link purposes by HRF.

TO:
HRFIS 3.2.3.2.1.1.1.20
The data to be transferred ~~may~~ shall be grouped in the following two categories:

- Files transfer~~ring~~: ~~That~~ includes MARES software updating, up-loading of experiments and down-loading of experiment~~s executions~~ related data~~.~~
- On line data transfer~~ring~~: real time transmission of experiment ~~execution related~~ and Health & Status (H&S) data for down-link purposes by HRF. H&S data (e.g. internal temperatures, voltages, fan speed) may be provided in the same packet as experiment (science) data. HRF will provide software to extract the H&S data from the on-line data for transmission or display.

3.2.3.2.2 MARES IP addresses
ADD:
The IP address ranges for HRF systems are shown in the table below:

	MARES Allocation	**Workstation**	**Portable Computer**	**MARES**
Rack 1	10.12.12.220 – 10.12.12.224	10.12.12.250	Rack 1 10.12.12. 21	10.12.12.220
Rack 2	10.12.16.220 – 10.12.16-224	10.12.16.250	Rack 2: 10.12.16.21	10.12.16.220

FROM:
HRFIS 3.2.3.2.2.1.1.10
The MARES IP address seen from HRF will be TBD.

TO:
HRFIS 3.2.3.2.2.1.1.10
The MARES IP address seen from HRF ~~will be TBD~~shall be 10.12.12.220 or 10.12.16.220. The MARES shall be capable of reconfiguring the IP address on-orbit without the use of special equipment or accessing internal parts.

FROM:
3.2.3.2.4 MARES file system
MARES has two 18 Gbytes removable units, that will be used as follow :

HRFIS 3.2.3.2.4.1.1.10
MARES will divide each disk in four 4gbytes partitions. Building on each partition a Dos file system, FAT 16, compatible with MS-DOS versions up to and including 6.2. Supporting filenames lenth up to 40 character.

TO:
3.2.3.2.4 MARES file system
MARES has two 18 Gbyte~~s~~ removable units, that will be used as follow~~s~~ ~~-~~:

HRFIS 3.2.3.2.4.1.1.10
MARES ~~will~~ shall divide each disk in four 4 Gg~~b~~byte~~s~~ partitions, ~~, B~~building on each partition a ~~Dos~~ DOS file system, FAT 16, compatible with MS-DOS versions up to and including 6.2, ~~, S~~supporting filenames len~~g~~th up to 40 character~~s~~.

FROM:
HRFIS 3.2.3.2.5.1.1.30
MARES will support the connection of only one client at the same time

TO:
HRFIS 3.2.3.2.5.1.1.30
MARES will support the connection of only one client at ~~the same~~ a time.

FROM:
HRFIS 3.2.3.2.5.1.1.50
Simultaneously with the experiment execution MARES will store the experiment data packets in its Hard Disk independently if a HRF connection is done or not. This will allow to recover the data by FTP (see section MARESHRF files transfer) in case of transmission error or no connection during experiment execution.

TO:
HRFIS 3.2.3.2.5.1.1.50
Simultaneously with the experiment execution MARES will store the experiment data packets in its Hard Disk independently if a HRF connection is done or not. This will allow HRF to recover the data by FTP (see section MARES-HRF files transfer) in case of transmission error or no connection during experiment execution.

FROM:
HRFIS 3.2.3.2.8.1.1.10
The network file system to be installed and configured by NASA on the Laptop Computers to be used with MARES will be the InterDrive Client v4.0 from FTP Software Inc.

The details related with its installation and configuration are stated in the Appendix A NFS Client, following the applicable templates defined in the HRF Software Development Plan LS-71020 section A4.0.

TO:
HRFIS 3.2.3.2.8.1.1.10
The network file system to be installed and configured by NASA on the Laptop Computers to be used with MARES ~~will~~ shallbe the ViewNow InterDrive Client ~~v4~~v7.0 from ~~FTP Software Inc~~NetManage.

The details related with its installation and configuration are stated in ~~the~~ Appendix A NFS Client, following the applicable templates defined in the HRF Software Development Plan LS-71020 section A4.0.

FROM:
3.2.3.3.2 Analog inputs eschematics

TO:
3.2.3.3.2 Analog inputs S~~es~~chematic~~s~~

FROM:
HRFIS 3.2.3.3.3.2.1.20
If the maximum waiting time expire, MARES will assume a transmission error, the current trasmission process (command or file) shall be aborted and the XON code will not be expected to start a new transmission process.

Any XON/ XOFF received out of secuence shall be discarted by MARES.

TO:
HRFIS 3.2.3.3.3.2.1.20
If the maximum waiting time expires, MARES will assume a transmission error, the current transmission process (command or file) shall be aborted and the XON code will not be expected to start a new transmission process.

Any XON/ XOFF received out of sequence shall be discarded by MARES.

FROM:
HRFIS 3.2.3.3.3.2.1.30
The MARES maximum delaying time, time between the XOFF and XON tasmission will be the equivalent to the transmission of 256 characters at the selected baudrate.

FROM:
HRFIS 3.2.3.3.3.2.1.30
The MARES maximum delaying time, time between the XOFF and XON transmission will shall be the equivalent to the transmission of 256 characters at the selected baudrate.

FROM:
HRFIS 3.2.3.3.3.3.1.10
MARES shall send the hole string command without introducing any contron code inside (XON/XOFF).

TO:
HRFIS 3.2.3.3.3.3.1.10
MARES shall send the whole string command without introducing any contron control code inside (XON/XOFF).

FROM:
HRFIS 3.2.3.3.3.3.3.20
MARES will support a continuos acquisition of 1Kbyte/s as a global throughput for the two serial interfaces.

TO:
HRFIS 3.2.3.3.3.3.3.20
MARES will support a continuous acquisition of 1Kbyte/s as a global throughput for the two serial interfaces.

ADD:
3.2.8 Fire Detection Interface

MARES shall use the ISS module area smoke detector for fire detection.

Delete:
4. Appendix A: NFS Client