

MARS Operations and Maintenance Manual: Outline

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Purpose

An outline for the operations and maintenance manual for the Monterey Accelerated Research System (MARS). This manual should contain all information necessary for day-to-day operations and regular maintenance on the MARS system, though it should avoid redundancy with vendor-supplied manuals and MARS drawings or schematics. The manual should contain both theory of operation and instructions for common maintenance tasks.

Goal is to have a logically organized manual which can be used as a quick introduction to the project and to particular components, though with the necessary depth to bring an engineer "up-to-speed" on the project before contributing. Frequently used information and basic troubleshooting should be easy to find with greater detail available by cross-reference or reference to a vendor manual. This document should be amenable to being broken into sub-volumes (i.e. LV Subsystem, MV Subsystem). It should also be amenable to an online version. An effort should be made to keep the manual "maintainable" i.e. information should be organized such that small system changes do not require widespread changes to the manual.

Scope

The manual encompasses the entire MARS system including the subsea node and cable, science ports, shoreside networking, power and any infrastructure unique to the MARS system.

Version

This is version A of this document, dated 16 August 2007.

Intended Audience

Personnel directly involved in the operation of the MARS system, including those operating the system on a daily basis and engineers asked to assist with maintenance or upgrade tasks.

Relevant Documents

This manual relies heavily on all available MARS documentation, including manuals supplied by collaborators (WHOI, UW-APL), subcontractors and vendors.

Deliverable

Outline: A detailed outline of the Operations and Maintenance manuals with some discussion of which elements are (and are not) found in each section. A "roadmap" for further development of the manual.

MARS Operations and Maintenance Manual

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1. Introduction: Overhead. Keep it brief.

1. Purpose
2. Scope
3. Version
4. Intended Audience
5. Conventions. (reference drawing/schematic lists, include note about use of hostnames vs IP addresses, reference IP address table at end of manual)

2. System Design Goals and Overview: An overview of system as a whole. Starts with design/science goals, keep it brief. Light on the history except for context. Give a functional block diagram and describes role of each component. Make it easy for someone to come up to speed on the "big picture", know where to look for more information (ah, it's a power problem, I'll look at the LV system)

3. Regular Operations: Gives a summary description of what's required to 'operate' the system on a day-to-day basis, with references to later 'Operations' sections (which are more step-by-step). Should be possible to distill this section into a checklist (if that's the preferred mode of operation). Basically a list of the various monitoring tools available and what "normal" looks like.

1. System start-up: How to start the node from a "cold" state.

2. System shut-down: How to shut the node down to a "cold" state.

3. Daily System Monitoring: Expectations, tools that should be used. Logging and recording i.e. will there be an "operator's log" of any sort?

4. Interface with Science users: Daily expectations of science users, including those with instruments being tested, those being deployed, and those that have been deployed.

4. Troubleshooting: Intended as a "start here" section for troubleshooting. Most likely a list of common scenarios and some debugging:

1. Instrument trips a circuit breaker

5. Mechanicals and Sea Cable

1. Introduction. Includes "physical block diagram" calling out major components and cables.

2. System Components

1. Node & Trawl-Resistant Frame. Description, purpose and a few pictures. Should explain the purpose, though shouldn't necessarily be a manual for recreating it from scratch. Reference to drawings.

2. Fluorinert FC-77. Basic discussion, handling

1. Filtering, reuse, disposal

3. Medium Voltage Housing. Basics on construction, internals, endcaps, cabling.

1. Construction and contents:

2. Maintenance

1. Opening housing

1. Draining Fluorinert

2. Sealing housing

1. Preparation for seal

2. Closing housing

1. He leak test

3. Filling with Fluorinert

4. LV Housing

1. Construction and contents: Basics about construction, bulkhead, interior frames, endcaps. Also science connectors and MV-LV housing cable.

2. Maintenance

1. Opening housing

1. Draining Fluorinert

2. Sealing housing

1. Preparation for seal

2. Closing housing

1. He leak testing

3. Filling with Fluorinert (I think the procedure is different for LV vs MV housings)

5. **Sea Cable and Cable Termination Assemblies:** Construction, part number, components of sea cable. Not much O&M information -- what can you do?

6. **Shore Station:** Location, what is the shore station. What does it contain? Reference to other sections of manual where those components are discussed. Also includes some of the infrastructure in the shore station -- UPS, fire alarm.

1. Ground farm.

3. **Operation:** Not a whole lot that can be done operationally (most of the shore station is really MV subsystem).

4. **Maintenance:** Again, not a whole lot can be done. Is it appropriate to include instructions (detailed or otherwise) on deploying/recovering the science node?

5. **Troubleshooting.** Much that can be done re troubleshooting? Nope.

6. Medium-Voltage (MV) Power Subsystem. With lots of help from Alcatel

1. **Introduction.** What is it, what does it do.

2. **High-Voltage Electrical Safety.** This is not intended to be a safety manual. Should basically say "if you haven't been trained in MV safety, don't work on the MV system"

3. **Shore Power Supply, Ground Farm, Safety Interlocks.** Describe intention, design and operation.

4. **Medium-Voltage Converter (MV Converter).** Describe intention, design. Reference Alcatel manuals as appropriate.

5. **Data gathered from MV converter/Sensor array in MV converter.** A bit more detail on the link from the MV system to the LV/PMACS realms, including information that's provided and what it means.

6. **Operation:** Focusing on operating the topside/Voltronics in greater detail than just "starting the system." Should include how-tos on the various safety/interlocking systems.

7. **Maintenance:** For safety reasons should be very, very short. Might be some troubleshooting on the shore power supply.

7. Low-Voltage (LV) Power Subsystem ([sections from UW O&M manual in blue](#))

1. **Introduction:** What is the LV system, where did it come from, what does it do. [Includes some UW material.](#) (Why was it designed this way?)

1. **Theory of Operation:** Block diagram, discuss flow through system, points where data is measured. Autostart

2. [Bus voltage monitoring](#)

3. [Ground fault monitoring and isolation](#)

4. [External Load Control and Monitoring](#)

1. [Load Control Circuit Breaker](#)

5. [Internal Load Control & Monitoring](#)

6. [Over Current Protection](#)

7. [System Grounding](#)

8. [Load Isolation](#)

9. **Temperature (1-wire) system.** Doesn't need its own section, I'd suggest shoehorning it into the LV subsystem.

2. **Circuit Boards:** Cover each board in more detail, show board, give theory of operation. Reference schematics and show detail as appropriate.

1. XBM (eXternal Bus Monitor)

2. XDC (eXternal DC converter)

3. XLC (eXternal Load Control)

1. LCCB "Daughter" board

2. Isolation "Iso" board

4. XLF (external Load Filter)

5. IDC Board

1. [Low voltage DC-DC converters](#)

1. [Thermal dissipation](#)

2. Reliability

6. ILC (Internal Load Control)

3. Node Power Controller: What it is, what it's doing.

1. Linux OS on NPC
2. Components:
 1. Processor, A/D, DIO boards
3. NPC Software (more detail below)
 1. More about autostart

4. Software:

1. PMACS Client:
2. PMACS Server: location, starting/stopping
3. NPC Software:
 1. SOAP interface
 2. iLoads
4. Temp sensor server. Theory, location, starting/stopping, interface to PMACS client
5. **Logs:** What's recorded where and how to retrieve it for analysis
 1. PMACS logs
 2. Temp server logs

5. Operations:

1. Starting client software, information and controls available.
2. Powering loads on/off
3. Setting limits
4. Ground faults
5. Dealing with errors

6. Maintenance

1. Logging into NPC over In-band, out of band system
 1. iLoads
2. Basic Linux ops
3. Building new NPC
4. Reinstalling PMACS client
5. Server software: starting/restarting. Checking on status. Installing/reinstalling. Configuration
6. Client software: Configuration. Installing/reinstalling.

7. Logs: what's being logged and where

8. Data Communications Subsystem (DCS) with help from WHOI

1. Introduction.

2. Software tools/Interface

1. **Intro:** Two kinds of software: background daemons and foreground web software
2. **Software running on DCS Server.** Starting/stopping. Interactions with the sail driver.
3. **Web interface**
4. **Logs:** what's available where

3. In-Band System

1. Overview

1. Network map and addressing scheme

2. Routers

3. Optical components

1. Optical basics, SFP/GBIC
2. Network electronics, GYDA
3. EDFAs
4. Physical infrastructure (what happens between leaving rackmount and entering LV can: shore cable, sea cable, CTA)

4. Out-of-Band System

1. Overview

2. Getting access

1. Serial port on DCS server
2. Digi server

3. The software/interface

1. Software on DCS server to simplify using the OBC

5. Timing System

1. Overview
 1. NTP
 2. 1PPS
2. Science port electrical interface for 1PPS

6. Operations:

1. Monitoring and usage of web client
2. Adding new devices to the network
3. Adjusting/monitoring the timing system.

7. Maintenance:

1. Logging into Ciscos via in-band or out-of-band channels
 1. Switching between node routers manually
2. Logging into the OBC
3. Maintenance and upgrade of DCS software. Installing/reinstalling. Configuration.
4. Diagnosing problems with optics: Not a comprehensive guide but a "getting started" w/ using optical meters.

9. **Computing Infrastructure:** Discusses the computer/software elements used for management of the MARS node as a computing/network system, and which are not specific to MARS as an marine installation.

1. **Support Networking Operation and Maintenance:** Most of this gear is just background noise till it breaks or you need to use it. Manual will include basic instructions to access/use equipment, then reference appropriate manuals for further information.

1. **Intro:** What's discussed in this section
2. Uplink connection to MBARI network/firewall (?):
 1. Interaction/ties to MBARI network, IS
3. Cisco 3750 switch basics
4. Cisco 3500XL switch basics
5. Other networking (switches) in MARS Lab:
 1. back doors for maintenance (3750 and 3500)
6. Other networking (switches) in Shore Station:
 1. Back doors for maintenance
7. HP Proliant Servers (in general)
 1. integrated Lights Out (iLO) interface
 2. Hot-swap hard drives
 3. Hot-swap power supplies
8. Red Hat Linux, RHN, upgrading software
9. Terminal server
10. Network boot bars
11. Network time server
12. UPS: One in shore station, one/several in MARS lab.
13. SVN and source control.

10. Wet Node Simulator (how much information to include?)

11. **Science Port:** Much more detailed discussion of science port. Procedure for testing/adding/removing packages. Could include as much or as little information about physical deployment as appropriate.

1. **Specification:** Detailed science port specification, ready to extract and hand off.

1. Mechanical (P/Ns)
2. Electrical: Pinouts and capacities. Include sample interface circuits
 1. Power capacities
 2. Network
 3. Timing
3. Network/bandwidth/services
4. Topside: available connectivity/services

2. Operations:

1. **Pre-deployment:**
2. **Testing in test tank/wet node simulator:**
3. **Add a new science package:** Power and network.
4. (day-to-day operations of science packages -- check connectivity and power -- rolled into top-level "day-to-day operations")
5. Hosting at MBARI, access over network

6. **Remove a science package:** Power and network.

3. Maintenance:

12.Index of Drawings: Index of drawings contained in separate volumes.

13.Index of Schematics: Index of schematics contained in separate volumes.

14.IP Address Map. Probably other network appendices as well.

15.List of Associated Documents: List of associated documents (vendor-supplied documents), contained in separate volumes.

16.Glossary

17.Table of Contents