RT 1000

Deployment Guide

January 25, 2011

Draft

R00.f

Part Number: 90-0004

wireless SEISMIC

When Real-time Matters

Wireless Seismic, Inc.
361 Centennial Parkway, Suite 230
Louisville, CO 80027
720.242.9916

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

All other brands, company names, product names, trademarks or service marks referenced in this material are the property of their respective owners, who may or may not be affiliated with, connected to, or sponsored by Wireless Seismic, Inc.

Wireless Seismic, Inc.'s trademarks, registered trademarks or trade dress may not be used in connection with any product or service that is not the property of Wireless Seismic, Inc., in any manner that is likely to cause confusion among customers, or in any manner that disparages or discredits Wireless Seismic, Inc. The products and services described in this material may not be available in all regions.

Draft

To order additional copies of this document, send an email to your sales representative requesting the following:

- Part Number: 90-0004-PDF
- Part Number: 90-0004-Paper

Table of Contents

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

List of Figures

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

List of Tables

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

1
Overview

1.1 About this Guide

This document provides information on how to deploy the RT 1000 in the field.

1.2 Who Should Use this Guide

The following table describes the typical seismic data acquisition users. The expected users of this document are as follows:

- Crew (Layout/Juggies)
- Technician (LTU)
- Troubleshooter
- Bosses (Line Crew)

Table 1–1 Roles and Responsibilities

Role	Responsibility
Bosses (Line Crew)	Responsibilities: • Supervise line crew personnel (juggies) • Drive and maintain the trucks used to transport personnel and equipment to and from field operations • Co-ordinate crew members boarding and exiting helicopters • Arrange the safe and orderly transport of equipment. Reports to: • Coordinator (Staging) **NOTE:** May occasionally visit the doghouse for clarification of instructions or updates on line status.

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Draft

Table 1–1 Roles and Responsibilities (cont.)

Role	Responsibility
Coordinator (Staging Coordinator / Landing Zone (LZ) Coordinator)	Responsibilities: • Journey management of all vehicles (including helicopters) and personnel to specific points within the prospect • Knowledge of all personnel in the prospect; knows when anyone enters or leaves the prospect, and where they go when they are there • Ensures that ground electronics (bag drops) arrive at the proper location • Controls inventory and general maintenance of equipment • Maintains constant contact with the crew and recorder • Oversees the testing of fresh equipment to be staged for the next layout. Reports to: • TBD **NOTE:** This role may be split in two, one person coordinating helicopter operations, and the other coordinating all line crew operations.
Coordinator (Survey)	Responsibilities: • Manages the survey crews. Survey work takes place in advance of the seismic crew, sometimes weeks or even months ahead of seismic crew mobilization. • Attempts to flag or stake every point starting with the *planned* receiver and source coordinates (delivered by the Oil Company Geophysicist or Birddog) • Adjusts flags or stakes when necessary based on physical accessibility (whether or not a vibrator or drill rig can get to a location), permitted corridor, and archeological or wildlife exclusion zones • Flags all access points and roads (in cooperation with the Staging Coordinator) • Delivers the *actual* coordinates to the Observer to be loaded into the Central Recording System • Provides updates to these coordinates during the project if ground conditions or permit conditions change • Ensures that the Central Recording System is configured with the correct datum and projection information Reports to: • TBD
Crew (Layout/Juggies)	Responsibilities: • Lay out the ground electronics • Pick up the ground electronics Reports to: • TBD

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Table 1–1 Roles and Responsibilities (cont.)

Role	Responsibility
Crew (Source)	Responsibilities: • Operators drive the vibrator trucks • Licensed shooters set off the dynamite • All crew remain in constant voice and data communication with the recorder during production **NOTE:** The source on a land seismic survey is usually either vibroseis or dynamite. Other source types such as poulter charges, accelerated weight drops, or shotguns may be used as well. One job may have multiple source types due to access or permit issues, such as steep slopes, masonry construction, and so on. Reports to: • TBD
Drillers	Responsibilities: • Drill source holes • May also load charge into the hole Reports to: • TBD
Geophysicist (Oil Company)	Responsibilities: • Survey design • Budget • Delivery of the final data to the Oil Company • Makes final decisions on recording parameters with the help of the Birddog • Visits the field once or twice during the project • Works closely with the Birddog to protect the interests of the Oil Company **NOTE:** The Geophysicist likely works on either an asset team responsible for oil or gas production in the field where the seismic shoot is taking place, or on a technical team responsible for all the company's seismic activity. Reports to: • TBD
HSE Manager	Responsibilities: • Ensures the health and safety of every person on the prospect • Ensures there is minimal environmental impact • Verifies that all environmental regulations are followed • Maintains any medical facilities in the field, such as a small first-response clinic or ambulance • Visits the Doghouse infrequently • Helps with the HSE component of the daily and final reports Reports to: • TBD

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Draft

Table 1–1 Roles and Responsibilities (cont.)

Role	Responsibility
Observer	Responsibilities: • Primary operator of the Central Recording System • Works in the Doghouse full-time • Coordinates all field activities during production • Monitors the status of the ground electronics • Organizes troubleshooting activities • Performs daily and monthly equipment tests • Controls source activation (vibrators, dynamite, and others) • Ensures the quality of the recorded data • Documents the recording operations • Determines, with the Staging Manager, which ground electronics need to be laid out and picked up in advance of or following source production • Remains aware of contractual obligations and works with the Crew to enforce them Reports to: • TBD
Observer (Junior/JO)	Responsibilities: • Usually an Observer-in-training, and will take over the Observer’s role when the Observer is taking a break • May also be the primary user of the voice radios in coordinating the operations • Works in the Doghouse nearly full-time Reports to: • TBD
Observer (Senior/SO)	Responsibilities: • Supervises overall seismic operations in the absence of the Party Manager Reports to: • TBD
Office Clerk	Responsibilities: • Maintains an office in the hotel or camp • Coordinates shipping to and from the field • Coordinates data delivery • Reports on deliveries • Meets with the Party Manager, Observer, and HSE manager at the end of each shift to provide detailed information for daily reporting Reports to: • TBD

© 2010-2011 Wireless Seismic, Inc. All rights reserved.
Draft

Table 1–1 Roles and Responsibilities (cont.)

Role	Responsibility
Oil Company representative (Birddog)	Responsibilities: • Makes independent observations and reports directly to the Oil Company, acting as oversight • Ensures that the contract is followed and that the seismic crew is always acting in the best interest of the Oil Company • A frequent visitor to the doghouse, keeps informed on all HSE and production statistics by *over-the-shoulder* observation of and conversations with the Observer • Often walks the line to ensure that geophones are properly coupled to the ground (*planted*), and ensures that the Observer is performing regular Quality Control (QC) of noise, leakage and geophone response (used to detect bad plants). Reports to: • Oil Company **NOTE:** The Birddog is either an employee of the Oil Company or is contracted directly by the Oil Company. He is often trained as a Geophysicist, and has frequently worked as an Observer, surveyor, or party chief in the past.
Party Manager / Party Chief	Responsibilities: • Leads the seismic crew; responsible for all operations • Acts as the primary point of contact for the Birddog • Maintains awareness of all HSE and data quality activities • Maintains focus on maximizing production and minimizing costs • A frequent visitor to the doghouse, keeps informed on all HSE and production statistics by *over-the-shoulder* observation of and conversations with the Observer Reports to: • TBD
Technician (LTU)	Responsibilities: • Builds and maintains the backhaul network using a ruggedized laptop or tablet PC running the Hardened Rib Application (HRA). This application has some of the functionality of the CSS, but streamlined for use as a troubleshooting tool. • In frequent communication with the Doghouse Reports to: • TBD

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Table 1–1 Roles and Responsibilities (cont.)

Role	Responsibility
Technician (Vibrator)	Responsibilities: • Maintains the mechanical and electronic health of the vibrators • Visits the Doghouse at job startup to set up the source controller communications and parameters • Returns to the Doghouse as maintenance requires Reports to: • TBD
Troubleshooters	Responsibilities: • Frequently visits the Doghouse to obtain a troubleshooting report (either printed or a file that can be loaded to a GPS device), which contains line/station numbers of failures as well as verbal instructions from the Observer. • Corrects ground equipment failures Reports to: • Observer

1.3 Other Documents

All RT 1000 documents are described in the *RT 1000 Documents Guide* (P/N 90-0001).

1.4 Getting Help

To get help on the RT 1000 Central Recording System, consult the online help. You can find the help documents by clicking the help icon in the user interface, or by navigating to the following directory:

- Directory Path TBD

To get help on the RT 1000 deployment, consult this document.

If you cannot find the answers you need, please contact Wireless Seismic, Inc. Technical Support at:

- 361 Centennial Parkway, Suite 230
  Louisville, CO 80027
  (720) 242-9916
- 13100 Southwest Freeway, Suite 150
  Sugar Land, TX 77478
  (832) 532-5080
- support@wirelessseismic.com

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Note:

Right now, a BSU is a standalone connection to a communication backhaul, power over ethernet box, and battery.

Ideally, everything would be in one box called the LTU:

- WSU
    - BSU
    - PoE
    - Battery
    - Backhaul Unit (mast)

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

2

Layout

2.1 Overview

This chapter describes how to prepare (mobilization) and layout (install) the ground electronics.

2.2 Mobilization

2.2.1 Prerequisites

Define

- Survey
- Back haul plan
- other?
-

2.2.2 Getting Ready

Possible topics for this section (basically collect all the pieces you need for the job):

NOTE *Please refer to Table 8–1 Antenna Specifications, on page 29 for the list of supported antennas. Use of accessories other than those specified in this document is not supported or warrantied.*

- List of WS equipment:
  - WRU
  - LTU
  - BSU
  - Antennas
  - Geophones
  - Batteries

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

    - Charging batteries
        - Charging Rack/# of batteries (10?)
        - Charging Times
  - Updating software in the central and ground units (maybe refer them to the sw chapter).
- List of non-WS equipment:
  - Dog House
    - power source (diesel, benzene or other type of fueled generator)
    - heating, cooling and ventilation system
    - antenna masts for voice radio, data telemetry, source control, and possibly satellite phone and/or internet
    - shock-mounted rack for PC, displays, servers, network devices, output devices, etc.
    - thermal plotter or equivalent
    - desk, chairs, small refrigerator and coffeepot
  - Safety equipment (vests, hard hats, etc.)
  - Computer, Monitors, Keyboard, Mice, etc.
    - Installing and testing interfaces
  - HHU? Is there a hand-held unit? (not currently)
  - Source controllers?
  - Other 3rd party equipment?
  - Shot equipment?
  - Two-way radios
- Preparing the equipment
- Making any equipment modifications
- Transporting equipment to the site
  - Best practices

2.3 At the Site

Prepare the Dog House / CSS HW & SW while the units (sensors & WRUs) are being placed in the field.

2.3.1 Set Up the Dog House

Set up the following in the dog house:

- Hardware
- Central Server (maybe refer them to the SW chapter)

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

2.3.2 Laying Out the Equipment

2.3.2.1 Prerequisites

Define the prerequisites.

The RT 1000 shall be used with only the supplied antennas (*Table 8–1 Antenna Specifications, on page 29*) attached to the WRU with an integrated type N male connector.

- The RT 1000 antennas shall be installed and handled by professionals specifically designated for this purpose.
- Changes or modifications not expressly approved by Wireless Seismic, Inc. can void the users's authority to operate the equipment.

WARNING *In order to comply with FCC radio frequency (RF) exposure requirements, the RT 1000 units must be installed so that a minimum separation distance of 20 cm is maintained between the antenna(s) and all persons at all times during normal operation.*

2.3.2.2 Placing the Equipment in the Field

List each piece of equipment with photo and call outs.

2.3.2.2.1 WRU

TBD

Figure 2–1 WRU

2.3.2.2.2 BSU

2.3.2.2.3 LTU

2.3.2.2.4 Geophone

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

3
Software

3.1 Overview

xxx

3.2 Installing the Software

xxx

3.3 Upgrading the Software

xxx

3.4 Upgrading the Firmware

xxx

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

4
Testing and Maintaining the Equipment

4.1 Overview

xxx

WARNING *In order to comply with FCC radio frequency (RF) exposure requirements, the RT 1000 units must be installed so that a minimum separation distance of 20 cm is maintained between the antenna(s) and all persons at all times during normal operation.*

4.2 Testing the Layout

xxx

the crew is doing roll-on, roll-off acquisition. This means that only part of the patch, ten lines, needs to be ready in order to begin production

parameter testing, can begin as soon as one line is laid out, connected, and tested

4.2.1 Line Tests

When the correct geometry has been applied to each WRU and the geometry accuracy has been confirmed, the Observer will begin line testing. In the warehouse before mobilization to the field the WRUs may have passed a series of BISTs (built in self tests), but these will need to be repeated after deployment. This can be done from the CSS, or can be done “ahead of the recorder” using an HRA in troubleshooter mode. Possible BISTs:

- Equivalent Input Noise (EIN)
- Total harmonic Distortion (THD)
- Pulse
- Calibration
- Channel gain and phase error

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

• Spread noise

• Geophone analysis (TBD)

• Pulse

• DC ohms

• DC leakage

• RF health

o Number of retries per unit

o KB/sec ???

o Power deviation (looking for a high Tx power unit)

o Rib throughput acceptable/not

• GPS position/timing QC

These tests should all be repeated at the CSS as communications are established with deployed nodes. In addition, the following tests should be conducted of the backhaul communications:

• Backhaul network confirmation (LTU-to-LTU-to-CSS test)

• Backhaul connectivity confirmation (BSU-to-LTU-to-CSS test)

The WRU BISTs can be executed at any time. If run during recording, any tests on the analog board or geophones will result in zero-ed data for the duration of the test. This may be desirable if one or more WRUs have reported a problem resulting in a skip-heal during high-productivity operations (skip-healing or self-healing is covered in another document). Tests can also be run during a pause in recording, or be sent to a queue to be automatically executed at the next pause in recording. Test results are written to the database, and can then be printed or written to a file, as in the case of delivering daily tests to the Birddog.

Each set of tests will be stored as a parameter set in the tree. The following matrix illustrates WS's recommendations for which tests should be run daily and monthly, and which are parts of continuous system health monitoring

TBD

4.2.2 Source Control Tests

Seismic Source's Universal Encoder (UE) is targeted to be the first source controller to be fully integrated with the CSS software. It will be connected to the CSS HW as part of an Ethernet LAN. The WS recording system shall support the same source types and configurations as the UE, including dynamite, multiple simultaneous vibrator fleets, and mixed source acquisition. When the shooters and/or vibrator tech have readied their sources, the Observer will establish radio contact, issue shooting commands, and investigate the content of the post-fire message. Test shots should be recorded, and correct timing, geometry, and header values should be confirmed. Further information on this workflow is found in the Production section

Vibrator similarity tests demonstrate the relationship between planned the sweep configured at the recorder and the measured ground force at the vibrator. This can

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Draft

be done over the source controller RF interface or when wired directly to the source controller. Hardwired similarity tests are more accurate, and the results will need to be compared to radio similarity tests. Similarity tests, as well as pulse tests to confirm that vibrators are synchronized, will likely need to be conducted at the beginning of the survey, and at sweep parameter changes. Radio similarities are conducted more frequently, measuring and recording raw ground-force versus time and phase versus time. Frequency of tests will be agreed to by the Oil Company and Seismic Contractor prior to the start of the project.

Dynamite control testing is simpler than vibroseis. Timing between the source controller and blaster pack can be verified using a storage scope. This is done by hooking up one scope input to the encoder and the other to each decoder that is to be used.

4.2.3 Acquisition Parameter Testing

For most surveys, except those where an Oil Company and/or seismic contractor have extensive local experience, the Oil Company will conduct a series of parameter tests. This will likely be under a separate pricing scheme in the contract, and may take a half to several days. In some cases an advance crew will be sent to an area to perform parameter testing. It may also take place with a subset of the patch, for example only a single receiver line. The parameters to be tested may include:

- Dynamite charge size
- Dynamite hole depth
- Dynamite hole array (number of holes and pattern)
- Vibrator array (number of vibrators and pattern)
- Vibrator sweep configuration

o Sweep length

For most surveys, except those where an Oil Company and/or seismic contractor have extensive local experience, the Oil Company will conduct a series of parameter tests. This will likely be under a separate pricing scheme in the contract, and may take a half to several days. In some cases an advance crew will be sent to an area to perform parameter testing. It may also take place with a subset of the patch, for example only a single receiver line. The parameters to be tested may include:

- Dynamite charge size
- Dynamite hole depth
- Dynamite hole array (number of holes and pattern)
- Vibrator array (number of vibrators and pattern)
- Vibrator sweep configuration

o Sweep length

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

You can record the parameter tests with one live receiver line while the layout crews are continuing to work on the next nine lines. This way, the parameter testing won’t consume any potential production time.

You can economize by combining some of the tests.

4.2.4 Built-In-Self-Test (BIST)

• A method will be provided for synchronizing tests across all WLSs

• Tests executed during deployment are for “go/no-go” purposes. The WRU will perform low-resolution evaluations of deployment tests and indicate the result with the battery LEDs. This is to save time and power and to reduce the effort required to write high-resolution evaluation in the WRU

There will be tests to implement in 2 places. We plan a “go no-go” test at the WRU that will be a simple calculation (not high precision) in order to assess if the channels and geophones are good. This could be done by Alex or someone like him. At the BSU application or LTU, the data for each of the test records (some tests have several records) would be sent from the WRU and processed with precision and the values for the tests calculated. I have someone that can write this software. The main reason to do this is when the system is audited the data and results for the same data, must be provided for analysis. If we do precision calculations at the WRU it adds complexity and may increase processing requirements

• Tests executed from the central system are for verifying the WRU specifications.

• WRUs will be commanded to execute internal and/or external tests. The data will be returned to the base station (in early development) or to the central system for high-resolution evaluation

Internal

During these tests the Geophone is disconnect electrically for the preamp. An internal test oscillator (where appropriate) drives the WRU analog channel in order to measure the characteristics of the Preamplifier and A/D. These tests should be run prior to running the external tests.

• Equivalent Input Noise (EIN)

• Total Harmonic Distortion THD

• Pulse

Calibration

• Channel Gain error and Phase error

B. External

During these tests the geophone is connected to the preamplifier and test circuitry for the purpose of measuring and characterizing the planted geophone. These

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

tests should be run only after it is established that there are no problems with the analog channel.

- Spread Noise
- Geophone analysis
- Pulse
- DC Ohms
- DC Leakage

4.3 Maintaining the Equipment

xxx

4.3.1 Units

4.3.2 Antennas

4.3.3 Geophones

4.3.4 Cautions

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

5

Rolling the Line

5.1 Overview

xxx

5.2 Process

the crew is doing roll-on, roll-off acquisition. This means that only part of the patch, ten lines, needs to be ready in order to begin production

Pickup and layout crews will be picking up lines behind production and laying them out ahead of production. Depending on battery charge state, equipment may circulate through staging or go directly from one line to the next.

In order to make most efficient use of layout crews, it is common to lay out entire receiver lines at a time even if they are longer than the template. This way crews don't need to spend time walking or driving from one line to the next picking up or laying out small amounts of equipment. However, if the size of the survey is large and receivers per line multiplied by the number of lines is larger than the number of channels available, it may be necessary to roll in the inline direction. In this case, it is necessary to be able to pick up and lay out WRUs in quantities smaller than a rib, for example increments of six WRUs.

During inline roll operations, it may be desirable to add newly deployed WRUs to an existing (discovered) rib. The Observer can instruct the last WRU in a rib to poll for neighbors during recording. Newly added WRUs can begin recording immediately.

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

6 Demobilization

6.1 Overview

xxx

6.2 Process

xxx

As soon as the Event Manager tool has determined that a WRU is no longer needed at that location, it will change color on the basemap. The Observer will need to consider the possibility of reshooting source points, which could happen if some recording failure is discovered later. Assuming no such reshoots, the Observer can undeploy the WRU or the entire rib. There will be no detrimental effect to either the ground electronics or the CSS database if the pick-up crew starts picking up the line before the Observer has undeployed it (e.g. if the backhaul is interrupted), as long as the Observer manually removes the picked-up WRUs from the deployed list at a later date. However, the preferred procedure for accurate asset tracking is to deploy from the CSS before physical pick-up.

Another option is for an LTU technician to undeploy a rib using the HRA while connected into the LTU/BSU. This can only be done when the rib has finished all recording operations. This requires that a message indicating which WRUs have been undeployed be sent to the CSS after this action.

Undeployment user action in the CSS can be either from the basemap or from a spreadsheet listing within the CSS application. An “are you sure” pop-up should be considered, especially for large numbers of WRUs and certainly for WRUs that haven’t been cleared by the Event Manager.

Once a WRU or rib is undeployed by the Observer through the CSS, it is up to the staging manager to ensure the physical pickup and asset tracking of the ground electronics. At the end of the project, the primary need the Observer has of the CSS is to ensure that all positional and trace data has been stored, backed up, and delivered properly. He will then need to power everything down and secure all hardware for transport.

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

7
Troubleshooting

7.1 Overview

xxx

7.2 Specifications

7.2.1 Ground Units:

- In summary, the unit must operate (from a power off condition) with an internal temperature ranging from -50C to +85C. The box performance specifications will be over the usual range of -40C to +70C.
- The system shall survive immersion in fresh or salt water (maximum of 5 m) for up to 1 day and still function to specification.
- The unit is not expected to operate at depth, but it should not corrode when submersed with battery packs. If the unit is self buoyant it will still be subjected to the test by forced submersion.
- The system shall survive a 2 meter drop onto ¾ inch plywood on concrete on any surface of the unit.
- This is the standard used by seismic manufacturer. Units will throw to the ground and into the back of trucks and they must be able to withstand this kind of shock
- The system shall have a removable antenna and still maintain its water seal with the antenna removed
- The system shall have removable desiccant packs inside enclosures
- The WRU shall meet all system requirements after being opened and closed for repair or maintenance in 95% humidity, 38°C environments.
- The battery pack shall have a shelf life of 1 year before needing a recharge
- A LI-Ion cell at about 60% to 80% charge level it should last at least 12 months when kept at 23°C. This will reduce to about 3 - 6 months at 40°C and 1 - 3 months at 60°C.
- The battery pack shall have minimum of 48 watt hours of capacity

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

- Battery must comply with runtime of unit. Two battery packs at minimum capacity should run the system for the required time (at 25C?). A cold temperature battery pack could be made available; for example, 8-10 cells.

7.2.2 Central Server:

- The central hardware shall have an operating range of 5°C to 55°C.
- The central hardware shall have adequate cooling to keep internal heat rise within 5 degrees of ambient.
- The central hardware shall operate on AC voltage with an input range of 84 – 260 volts at 50 to 60 hertz.
- The central hardware shall be capable of operating in a dusty environment
- The central hardware shall be capable of connecting to an industry standard source controller cable
- Prior to mobilization, the Observer will ensure that the installed CSS revision is the most recent reliable version available. Unless needed to replace major system error/defect, the system software should not be updated during the Survey. In the event of a major recording system failure, a complete instrument test will be run and operations are not to resume until tests are approved by the Birddog.

7.2.3 Battery Charger:

- The battery charger shall operate on AC voltage with an input range of 84 – 260 volts at 50 to 60 hertz.

  Some power conditioning may be required for use with generators.
- The battery charger shall have an operating range of 5°C to 55°C
- The battery charger module should be capable of running on a standard 20 amp breaker (@120 volts) with the charger fully loaded

7.2.4 Batteries:

- When two batteries are attached the WRU will choose the battery with the lowest acceptable charge. This battery will be used until it is completely discharged to a defined value then the WRU will switch ports and flash the appropriate LEDs to notify the crew which battery is in use and which needs to be replaced.
- When a second battery is not available, the WRU will discharge the battery until the regulator can no longer supply proper voltage to the watchdog or the battery pack protection circuit shuts off the battery at 2.8V
- If a battery is discharged to point the pack protection board shut the battery off, the battery pack should be charged within two weeks of this occurrence

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

7.3 LED Chart

Insert the chart showing possible LED situations and what they mean.

Throughout the project, there will likely be intermittent problems with the ground electronics. Failures can result from poor initial deployment, general wear and tear, lighting strikes or other acts of god, livestock and wildlife, or vandalizing (or curious) humans. When these problems must be solved physically, the Observer will use troubleshooters. Battery replacements fall into this category as well, if only an anomalous few need to be replaced within the spread.

The troubleshooters, as noted in the User Story section, will have quick transportation (usually a mule or ATV), a collection of spares and tools, and a reasonable level of technical skill and training. The Observer will provide him with a printed list or file that can be loaded to a GPS. It will include:

• Location (X/Y and line/station)

• Faulty piece of equipment (geophone string, LTU/BSU, WRU)

• Nature of problem (GPS failed, dead battery)

• Prioritization

As each issue is addressed, the troubleshooter will communicate the action to the Observer. At any point after this communication, the Observer will want to issue a command to the WRU in question, such as battery or geophone test. This can be issued immediately, tests that involve the analog circuit will result in zero-ed data from that WRU for as long as the test takes. It can also be sent to a queue, where the command is sent automatically when there is a pause in production. This is a part of the event management tool. This queue also handles duty cycle issues- where a WRU power state requires commands to wait for a particular interval.

When a WRU has failed, the rib will automatically skip-heal. This means that adjacent WRUs will communicate around the dead WRU, so that recording can continue uninterrupted. If a troubleshooter replaces or repairs the WRU, re-creation of the rib can only happen when production is paused. This can be done on command, or can be queued as with other testing commands.

In addition to troubleshooting reports, the Observer will be able to generate a battery report. This will contain all health information about any battery that has sent data to the CSS. Indexed by line/station or serial number, it will report the number of charge cycles, current charge state, and any other available statistics.

Troubleshooting

• All troubleshooting functions will be performed in the active and not the acquiring state

• The units must be commanded to stop sending seismic data; however the cycle-mode will remain active to facilitate the troubleshooting process.

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

• The CRA will contain functions that can be used with a BSU to perform the following on demand tests:

o No GPS position

Position is invalid because not enough satellites were acquired. This should only need to be done at initial WLS discovery. GPS should not be turned on when analog is on. Operator should be able to turn on the GPS receiver for a specified time. If no position can be determined then the operator should be able to review the neighbor information to determine the unit's line and station and manually set it in the application.

o WRU replacement (user initiated)

A unit may need to be replaced for any number of reasons determined by the operator. The uplink and downlink neighbor of the unit being replaced would be told that its neighbor is being changed and it (downlink unit) should be sent an undeploy command by serial number. Once the replacement WRU has been changed, this unit should be activated by troubleshooter and it will execute the self and neighbor discovery process. The uplink and downlink neighbors of the replacement WRU should perform a WLS discovery with the new unit and add it to the list of units in WLS.

o Geophone troubleshooting

This is a case where a geophone has been identified as bad and there is a troubleshooter at the unit. Select the units and perform any geophone test available. These tests can be run as a suite or individually. The units) would need to be told to turn on analog power and would begin to send data to CRA for analysis. For more detail on analyzing test data see "WRU built in self tests".

o Battery management

This test when a battery is to be replaced and tested to verify that it is a good battery. Select the unit and request battery status the WRU. Display data for both batteries if present.

o Analog channel evaluation

This test is performed when a geophone has been replaced with a new one and test is still bad. Run the internal tests to determine if the channel is bad and the WRU needs to be replaced. These tests can be run as a suite or individually. The units) would need to be told to turn on analog power and would begin to send data to CRA for analysis. For more detail on analyzing test data see "WRU built in self tests".

o Deployment test with tolerance parameters on demand

In the active state, propagate a command downlink in the heartbeat to an individual WRU to run the go-no-go test suite with a specified tolerance and indicate on LEDs test results and report pass/fail to the WS manager in next heartbeat.

Note special care will have to be taken with tilt switches during battery replacement. A user-gesture may be used to assist this process.

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

8
Legal Information

8.1 FCC Rules and Regulations Compliance

The Federal Communications Commission (FCC) regulates the use of antennas in the "*Code of Federal Regulations – Title 47, Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators, Section 15.203 Antenna Requirement*."

NOTE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

When used as intended, the RT 1000 complies with FCC Section 15.203 requirements as follows:

- The RT 1000 antennas shall be installed and handled by professionals specifically designated for this purpose.
- Changes or modifications not expressly approved by Wireless Seismic, Inc. can void the users's authority to operate the equipment.
- The RT 1000 shall be used with only the supplied antennas (*Table 8–1*) attached to the WRU with an integrated type N male connector.

Table 8–1 Antenna Specifications

Model	Frequency (MHz)	Gain	Vertical Bandwidth	Weight	Dimension (Length x Diameter)
WSI 65-0023	2400-2485	5 dBi	25º	0.5 lbs 0.2 kg	12 x 0.6 in 355 x 15 mm
WSI 6060-001-01	2400-2485	7 dBi	18°	0.6 lbs 0.3 kg	21 x 0.6 in 540 x 15 mm

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Draft

Table 8–1 Antenna Specifications (cont.)

Model	Frequency (MHz)	Gain	Vertical Bandwidth	Weight	Dimension (Length x Diameter)
WSI 65-0025	2400-2485	2 dBi @ 2.4	120°	1.6 oz 45.4 g	7.6 x 0.5 in 193 x 12.7 mm

WARNING *In order to comply with FCC radio frequency (RF) exposure requirements, the RT 1000 units must be installed so that a minimum separation distance of 20 cm is maintained between the antenna(s) and all persons at all times during normal operation.*

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Glossary

Draft

channels/line	288
channels/patch	4608
crossline size	52800 ft
inline size	31680 ft
lines/patch	16 describe the shooting template the number of lines that should be live
max inline offset	13200 ft The “max inline offset” is the longest raypath, or lateral distance between source and receiver, desired for the imaging target. This describes half the inline (receiver line) length of the recording template.
receiver interval	110 ft describe the basic geometry of the points on the ground- the spacing of points on a line and the spacing of the lines themselves
receiver line interval	1650 ft describe the basic geometry of the points on the ground- the spacing of points on a line and the spacing of the lines themselves
receiver lines	32
roll-on / roll-off	10 lines
source interval	220 ft describe the basic geometry of the points on the ground- the spacing of points on a line and the spacing of the lines themselves

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

source line interval	1760 ft describe the basic geometry of the points on the ground- the spacing of points on a line and the spacing of the lines themselves
source lines	18
swath width	3 lines describe the shooting template the number of continuous source points that will be shot into a live patch swath width of three lines means that three receiver line’s worth of source points will be shot before the source crews move down the receiver line and continue the other direction on the next source line

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

Index

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.

U

Draft

© 2010-2011 Wireless Seismic, Inc. All rights reserved.