

Technical Specifications of Front End Mobile Unit

February 2007

PART I – Real Time Tracking & Monitoring of Vessel (RTTMV) System Design

The RTTMV system consists of an Application Server (first tier) for managing data communication and system functions; a Primary Database Server (middle tier) for data storage; a Web Server and two workstations (third tier) for user applications. Computer apparatus are inter-connected through local area network switches and firewall. A dedicated leased line connection is used between the EPD control centre (CC) and GSM network operator, whereas FEMU are connected to the GSM network operator through the GPRS network. A broadband connection to the global internet is connected to the firewall for providing external access to the web server.

PART II – Front End Mobile Unit (FEMU) System Components Diagram

The FEMU, as illustrated in Figure 1, consists of a data capturing and communication unit, a processing unit, data storage media, a portable printer, a GPS receiver, a draught sensor, a split-bottom control button, a network camera and backup batteries. The FEMU is housed in a waterproof enclosure with key locks.

Data records are sent back to EPD Control Center for real-time monitoring and short dumping detection. Data records transmitted and stored in Control Center should be identical to the corresponding virgin data captured and stored in FEMU.

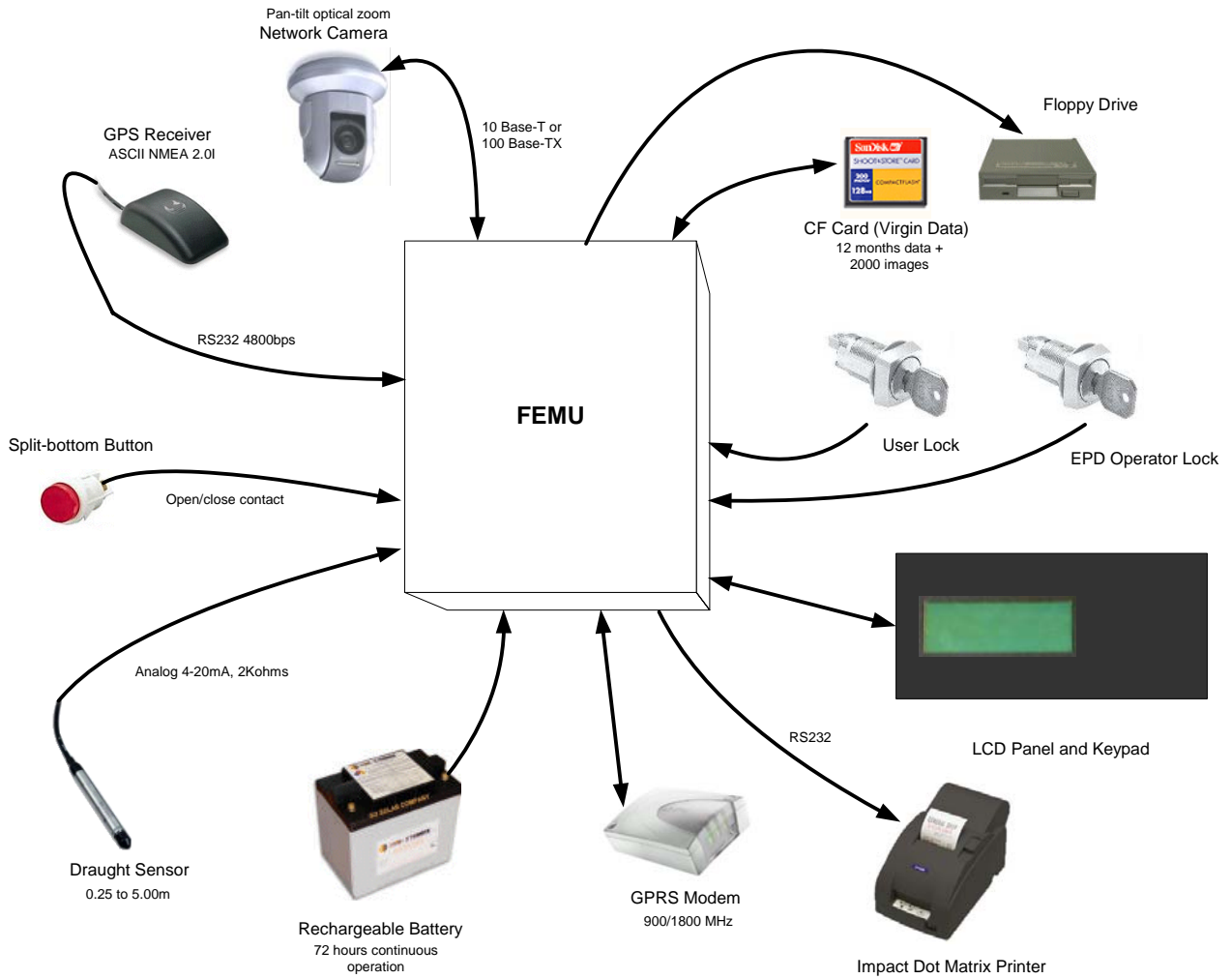


Figure 1 – Front End Mobile Unit (FEMU)

PART III – FEMU Functional Requirements

- Capture GPS positioning data from GPS receiver.
- Capture draught level from draught sensor and convert it from analog electrical signal to digital data.
- Detect split-bottom control button status.
- Control network camera and take snapshots.
- Interface with key locks for managing system configuration and data downloading.
- Display basic information including date and time, position and speed of vessel, accuracy of GPS positioning, draught level, split-bottom control button status, distance from dumping site etc.
- Process and analyze data in real-time.
- Produce visual and audio signal when vessel enters or leaves specified marine dumping site.
- Produce visual and audio signal on system alerts.
- Generate data integrity signature.
- Store unprocessed (virgin) data with data integrity signature associated to removable non-volatile memory. Capable for storing 12 months virgin data and 2000 JPEG images.
- Communicate with Control Center and send data to Control Center via GSM/GPRS.
- Adjust data recording and reporting interval automatically.
- Authenticate user.
- Change system settings and parameters locally or remotely via GSM/GPRS.
- Take snapshots by request locally or remotely via GSM/GPRS.
- Retrieve data from data storage media and send to printer.
- Retrieve data from data storage media and send copy to removable media.

PART IV – Hardware Specifications

FEMU	
Features	
Signal range and data rate:	Analog input: 0 to 20 mA for draught sensor Digital input: Open/close detection for split-bottom button RS232 input: Baud rate 4800bps for GPS receiver RS232 output: User selectable for portable printer Network: 10 Base-T or 100 Base-TX for digital camera
Communication:	Type: Wireless Network: GSM/GPRS/EDGE/UMTS 900/1800 MHz Protocol: TCP/IP
Display:	Type: LCD, color or black/white Character: Alpha numeric, English and Chinese
Indicators/alerts:	LCD, LED, buzzer on events: <ul style="list-style-type: none"> ◆ System status ◆ Communication status ◆ Sensors and button status ◆ Distance from specified marine dumping site ◆ Audible signal when vessel enters and leaving specified marine dumping ground ◆ Battery level and battery low alert ◆ AC power outage (if appropriate)
Input:	Numeric keypad
Access:	Key locks User ID and password
Settings:	Updated locally or remotely <ul style="list-style-type: none"> ◆ Loading and dumping site coordinates ◆ Vessel information ◆ Trip information ◆ Data recording intervals ◆ Data reporting intervals ◆ Usernames and passwords

Data recording and reporting	
Data types:	Unprocessed (virgin) data from GPS receiver, draught sensor and split-bottom button
Recording intervals:	6 user configurable intervals for: Idle and far from disposal sites (default 5 minutes) Idle and near disposal sites (default 5 minutes) Sailing and far from disposal sites (default 1 minute) Sailing near disposal sites (default 20 seconds) Inside disposal sites (default 10 seconds) Dumping (default 1 second)
Reporting intervals:	6 user configurable intervals for: Idle and far from disposal sites (default 5 minutes) Idle and near disposal sites (default 5 minutes) Sailing and far from disposal sites (default 1 minute) Sailing near disposal sites (default 1 minute) Inside disposal sites (default 1 minute) Dumping (default 30 seconds)
Virgin data	
Format:	Syntax: <1>,<2>,<3>,<4>,<5>,<6> <1> = Vessel ID, 000001 – 999999 <2> = Draught (direct analog-to-digital input), 0000 – 9999 <3> = Split-bottom sensor, 0 = activated, 1 = inactive, X = unavailable <4> = Number of satellites in use, 00 to 12 (leading zeros will be transmitted) <5> = Complete ‘Recommended Minimum Specific GPS/TRANST Data’ (\$GPRMC) sentence defined in NMEA 0183 Version 2.0, from \$GPRMC to checksum *hh <6> = 160-bit integrity checksum, (presented in corresponding 40 ASCII characters of their hex values)
Integrity checksum:	160-bit digest computed by SHA-1 algorithm Inputs to SHA-1 calculation: - 128-bit digital signature of EPD (updated regularly) - 128-bit digital signature of barge operator (updated regularly) - <1>,<2>,<3>,<4>,<5>

Storage:	Removable non-volatile memory At least 12 months complete virgin data records At least 2000 JPEG images at 320x240 resolutions
Data Retrieval	
Peripheral:	Floppy disk driver
Access:	Key lock User ID and password
Output:	Vessel ID Selected trip information: <ul style="list-style-type: none"> - Dump site - Dump site position - Trip date (YYYY-MM-DD) - Trip time (From HH:MM:SS to HH:MM:SS) - Number of records Selected data records (copy of virgin data) Selected images
Image Capturing	
Capturing:	Auto capture during dumping By request (local or remote)
Configuration:	Select preset position (local or remote) Adjust pan-tilt-zoom (local or remote) Change resolutions (local or remote)
Filename:	Syntax: IMGnnnnnn_c_YYYYMMDDhhmmss.jpg nnnnnn = Vessel ID c = camera Id YYYYMMDD = capture date hhmmss = capture time
Printing	
Peripheral:	Serial impact dot matrix printer
Interface:	Standard RS232, DB9 male
Access:	Key lock User ID and password

Output:	<ul style="list-style-type: none"> - Vessel ID - Dump site - Dump site position - Trip date (YYYY-MM-DD) - Trip time (From HH:MM:SS to HH:MM:SS) - Number of records - Snapshots taken at records (XX, YY, ZZ ..., or nil) - In each record: <ul style="list-style-type: none"> ◆ Trip time (HHMMSS) ◆ Latitude and Longitude (dd.mmmm, ddd.mmmm) ◆ Number of satellite signals received ◆ Draught level ◆ Bottom status (open or close) ◆ 8-bit checksum for each record <p>160-bit data integrity signature (presented in corresponding 40 ASCII characters of their hex values) for all printed records</p>
Physical	
Enclosure:	IP 65 or NEMA 4X weather proof
Protection:	Key locks
Environmental:	Operating temperature: 0 – 60°C (internal) Operating humidity: 20% – 80% relative humidity, non-condensing (internal)
Power	
Input voltage:	110/220 VAC 9 to 40 VDC
Backup power:	Battery charger Rechargeable battery, sustainable for 72 hours continuous operation

Draught Sensor	
Features	
Type:	Level pressure sensor
Measure range:	0.25 to 5.00 meters
Resolution:	±0.06%
Accuracy:	±0.1% Full Scale Baltic Sea Level (BSL) maximum
Interface (output):	2 wires 4 to 20 mA proportional for zero to FS pressure Output impedance: 2K ohms nominal
Temperature compensation:	Built-in
Physical	
Enclosure:	IP 65 or NEMA 4X, immersed in seawater
Environmental:	Operating temperature: -20 to 60°C
Power	
Input voltage:	12 to 28 VDC
Protection:	Surge arrestor

GPS Receiver	
Features	
Receiver:	12 channels
Acquisition times:	20 seconds warm (all data known) 60 seconds cold (initial position, time and almanac known) 10 minutes search the sky (no data known)
Update rate:	1 second, continuous
Accuracy:	20 meters RMS
Interfaces:	RS-232 compatible with baud rate 4800bps NMEA 0183 version 2.0 ASCII output (GPGGA, GPGSV, GPRMC)
Physical	
Antenna:	Outdoor weather proof
Environmental:	Operating temperature: -20°C to +80°C (internal)
Power	
Input voltage:	9 to 30 VDC, unregulated
Backup power:	Internal rechargeable battery



Digital Camera	
Features	
Image/video compression:	JPEG or MJPEG
Image/video resolutions:	640x480, 320x240, 160x120
Pan, tilt and zoom:	±45° Pan, >30° Tilt and >4x optical zoom
Preset positions:	3
Sensor type:	CCD 300,000 pixels
Focus:	Auto
Exposure:	Auto
Illumination:	Minimum 1 lux
Interfaces:	10 Base-T or 100 Base-TX
Physical	
Enclosure:	IP 65 or NEMA 4X, outdoor weather proof
Environmental:	Operating temperature: 0 to 40°C (internal) Operating humidity: 20% to 80% relative humidity, non-condensing (internal)
Power	
Input voltage:	110/220 VAC 9 to 30 VDC, unregulated



PART V – Communication Protocol

FEMU – to – Server

Front-End Mobile Unit Minimum Sensor Reading (MSR)
\$FEMUMSR,<1>,<2>,...,<n>*hh<CR><LF> <1> = Number of virgin data records, 0 – 9 <2>...<n> = Virgin data records
Front-End Mobile Unit System Status Information (SSI)
\$FEMUSSI,<1>,<2>,<3>*hh<CR><LF> <1> = Vessel ID, 000001 – 999999 <2> = Battery level, 00.00 – 99.99 <3> = AC/DC power source, A = available, U = unavailable
Front-End Mobile Unit Captured Image Data (CID)
\$FEMUCID,<1>,<2>,<3>,<4>*hh<CR><LF> <1> = Vessel ID, 000001 – 999999 <2> = Filename <3> = Size in bytes of image data, 00001 – 99999 <4> = Image data, binary data string
Front-End Mobile Unit Response to Command (R2C)
\$FEMUR2C,<1>,<2>,<3>*hh<CR><LF> <1> = Vessel ID, 000001 – 999999 <2> = Response to message type, RAR; RCI; SCP; CRI; CCI; SDS <3> = Response, ACK = Acknowledged, NAK = Not acknowledged
Front-End Mobile Unit User Specific Response (USR)
\$FEMUUSR,<1>,<2>,<3>*hh<CR><LF> <1> = Vessel ID, 000001 – 999999 <2> = Response message length, 0000 – 9999 <3> = Response message content, text/binary data string

Front-End Mobile Unit Recording and Reporting Interval (RRI)

\$FEMURRI, <1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>*hh<CR><LF>

<1> = Vessel ID, 000001 – 999999

<2> = Recoding interval of idle and outside disposal site, 000 – 999 seconds

<3> = Recoding interval of sailing outside and away from disposal sites, 000 – 999 seconds

<4> = Recoding interval of sailing near disposal sites, 000 – 999 seconds

<5> = Recoding interval of sailing inside disposal sites, 000 – 999 seconds

<6> = Recoding interval of dumping, 000 – 999 seconds

<7> = Reporting interval of idle and outside disposal site, 000 – 999 seconds

<8> = Reporting interval of sailing outside and away from disposal sites, 000 – 999 seconds

<9> = Reporting interval of sailing near disposal sites, 000 – 999 seconds

<10> = Reporting interval of sailing inside disposal sites, 000 – 999 seconds

<11> = Reporting interval of dumping, 000 – 999 seconds

Front-End Mobile Unit Existing Disposal Sites (EDS)

\$FEMUEDS,<1>,<2>,<3>,<4>....,<5>*hh<CR><LF>

<1> = Vessel ID, 000001 – 999999

<2> = Number of vertices

<3> = Latitude of vertex 1, ddmm.mmmm format (with leading zeros)

<4> = Longitude of vertex 1, dddmm.mmmm format (with leading zeros)

Repeat <3>,<4> for all vertices

<5> = Entering or leaving disposal sites alert distance, 0000 – 9999 meters

*hh = Checksum for parity checking based on algorithm used in NMEA 0183.

Server – to – FEMU

EPD Control Center Request Ad-Hoc Readings (RAR)
<p>\$ECCRAR,<1>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p>
EPD Control Center Request Capture Image (RCI)
<p>\$ECCRCI,<1>,<2>,<3>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p> <p><2> = Image resolution,</p> <ul style="list-style-type: none">0 = 160 x 120,1 = 320 x 240,2 = 640 x 480,3 = 176 x 144,4 = 352 x 288,5 = 704 x 576. <p><3> = Image quality,</p> <ul style="list-style-type: none">0 = Lowest quality,1 = Normal quality,2 = High quality.
EPD Control Center Set Camera Position (SCP)
<p>\$ECCSCP,<1>,<2>,<3>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p> <p><2> = Preset position, 1 – 9, M = move or zoom</p> <p><3> = Move direction,</p> <ul style="list-style-type: none">L = Move left,R = Move right,U = Move up,D = Move down,Z = Zoom in,P = Pan out.

EPD Control Center Change Reporting Interval (CRI)
<p>\$ECCCRI,<1>,<2>,<3>,<4>,<5>,<6>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p> <p><2> = Reporting interval of idle and outside disposal site, 000 – 999 seconds</p> <p><3> = Reporting interval of sailing outside and away from disposal sites, 000 – 999 seconds</p> <p><4> = Reporting interval of sailing near disposal sites, 000 – 999 seconds</p> <p><5> = Reporting interval of sailing inside disposal sites, 000 – 999 seconds</p> <p><6> = Reporting interval of dumping, 000 – 999 seconds</p>
EPD Control Center Change Recoding Interval (CCI)
<p>\$ECCCCI,<1>,<2>,<3>,<4>,<5>,<6>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p> <p><2> = Recoding interval of idle and outside disposal site, 000 – 999 seconds</p> <p><3> = Recoding interval of sailing outside and away from disposal sites, 000 – 999 seconds</p> <p><4> = Recoding interval of sailing near disposal sites, 000 – 999 seconds</p> <p><5> = Recoding interval of sailing inside disposal sites, 000 – 999 seconds</p> <p><6> = Recoding interval of dumping, 000 – 999 seconds</p>
EPD Control Center Set Disposal Sites (SDS) (revised on 1-AUG-2005)
<p>\$ECCSDS,<1>,<2>,<3>,<4>,<5>,<6>,...,<7>*hh<CR><LF></p> <p><1> = Vessel ID, 000001 – 999999</p> <p><2> = Index, 0 – 2</p> <p><3> = Zone ID, 000 – 999</p> <p><4> = Number of vertices, 3 – 6</p> <p><5> = Latitude of vertex 1, ddmm.mmmm format (with leading zeros)</p> <p><6> = Longitude of vertex 1, dddmm.mmmm format (with leading zeros)</p> <p>Repeat <5>,<6> for all vertices</p> <p><7> = Entering or leaving disposal sites alert distance, 0000 – 9999 meters</p>
<p>*hh = Checksum for parity checking based on algorithm used in NMEA 0183.</p>