EMS Requirements Specification

Version 1.1

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1. Introduction

1.1 Purpose

The purpose of this Software Requirements Specification (SRS) document is to determine the requirements imposed on the design of the Extensible Measurement System (EMS) by its prospective users. This document specifies the required functionality, and extensibility of the system. It describes also the computer platforms upon which the system will be implemented. This SRS is intended to be reviewed by (organizational elements) directly affected by the design such as: operations personnel, software designers, programmers, and other users of the system (physicists).

1.2 Scope

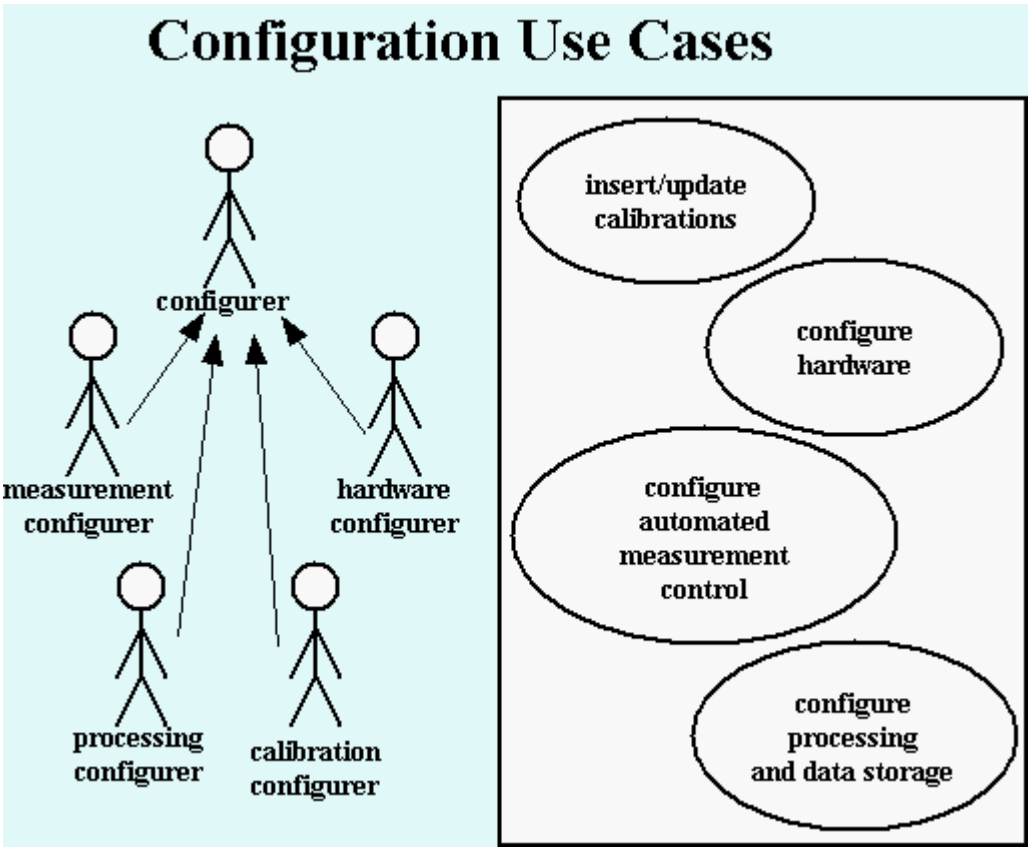
The goal of the Extensible Measurement System project is to design, implement, and deploy a measurement system which is extensible, configurable, and flexible, and therefore suitable for R & D environments. It will accommodate present and future data acquisition sources and data stores. This work will replace existing magnetic measurement systems as well as provide a framework for future measurement development.

1.3 Overview

This SRS will describe various requirements grouped into three sections describing general functional requirements and limitations, core system requirements, and use cases.

2. Use Cases

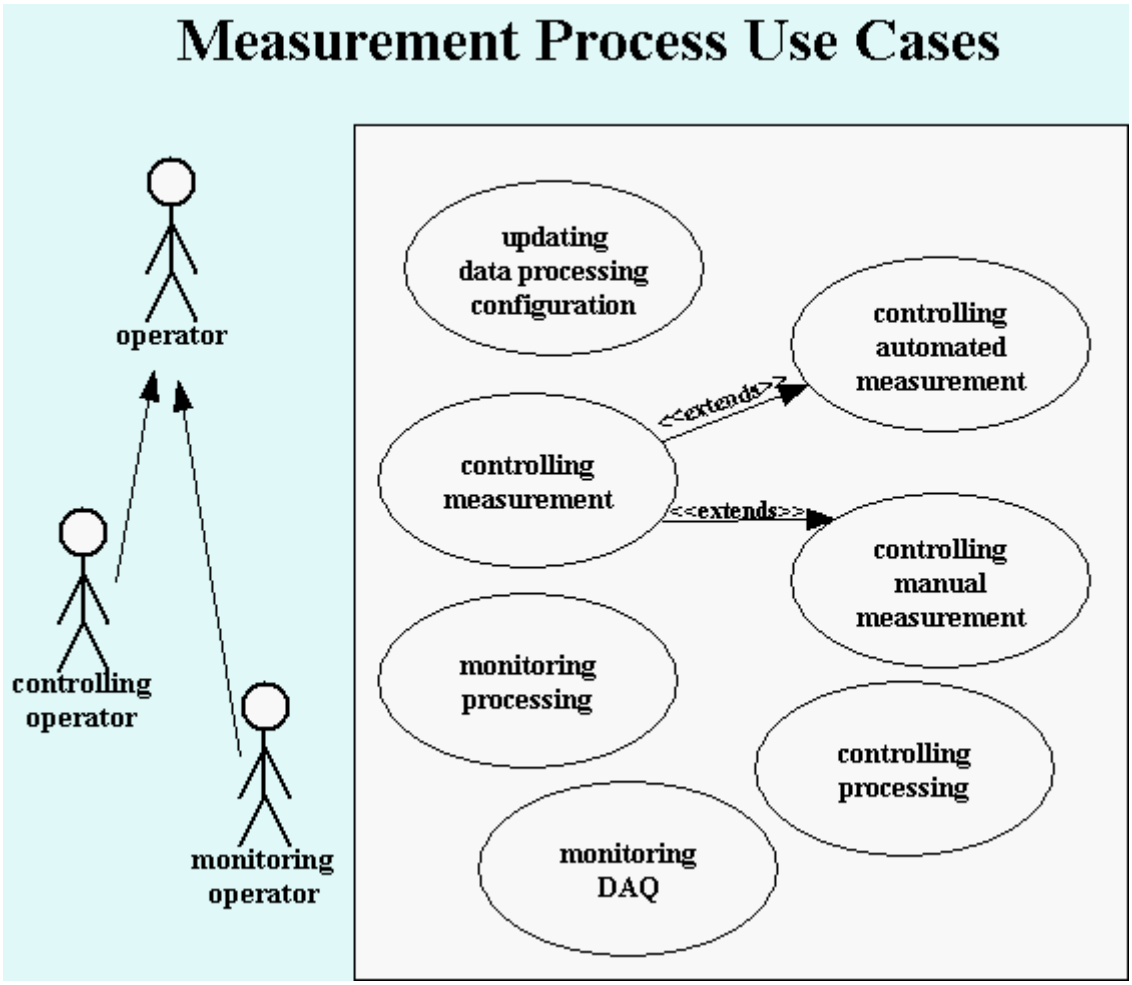
2.1 Configuration Use Cases (UC1)



Several aspects of the measurement system can be configured indepently in different ways.

1. A calibrations configurer will insert and/or update calibrations.
2. A hardware configurer will insert/update hardware settings.
3. A measurement configurer will create a script from which automated measurements will be run.
4. The processing configurer will "connect" the data source (DAQ, data file) with various processing algorithms and visualization methods, as well as specify the storage medium for end (and possibly intermediate) products of the processing.

The storage medium for the result of each of these configuration actions will be predicated on the best available medium for the hypothetical individual performing the configuration. These storage mediums will probably be a single choice for each type of configuration from the following possible mediums: SQL relational databases, Object Oriented Databases, flat files.



2.2 Measurement Process Use Cases (UC2)

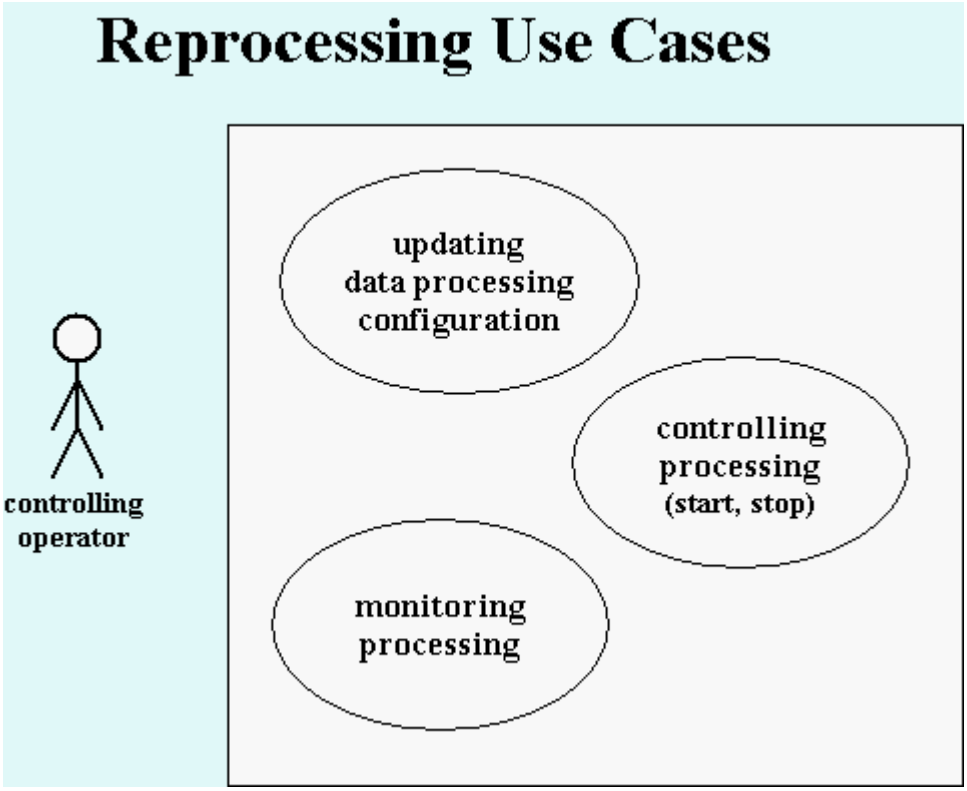
There are two roles an operator can take during a measurement. One is the controlling role, in which the operator changes some condition or parameter of the measurement during the measurement. The other is a simple monitoring role, in which intermediate (and end) result data is viewed.

The monitoring operator may examine data from the Data Acquisition (DAQ) portion of the system and data from intermediate and final processing. The monitoring operator may save data specific to the type of monitoring they perform.

The controlling operator may:

start or end the controlling program for the entire measurement system
control the automated measurement (begin or end the measurement)
control a manual measurement
update the data processing configuration (e.g. add a new view of the data, change processing algorithms)

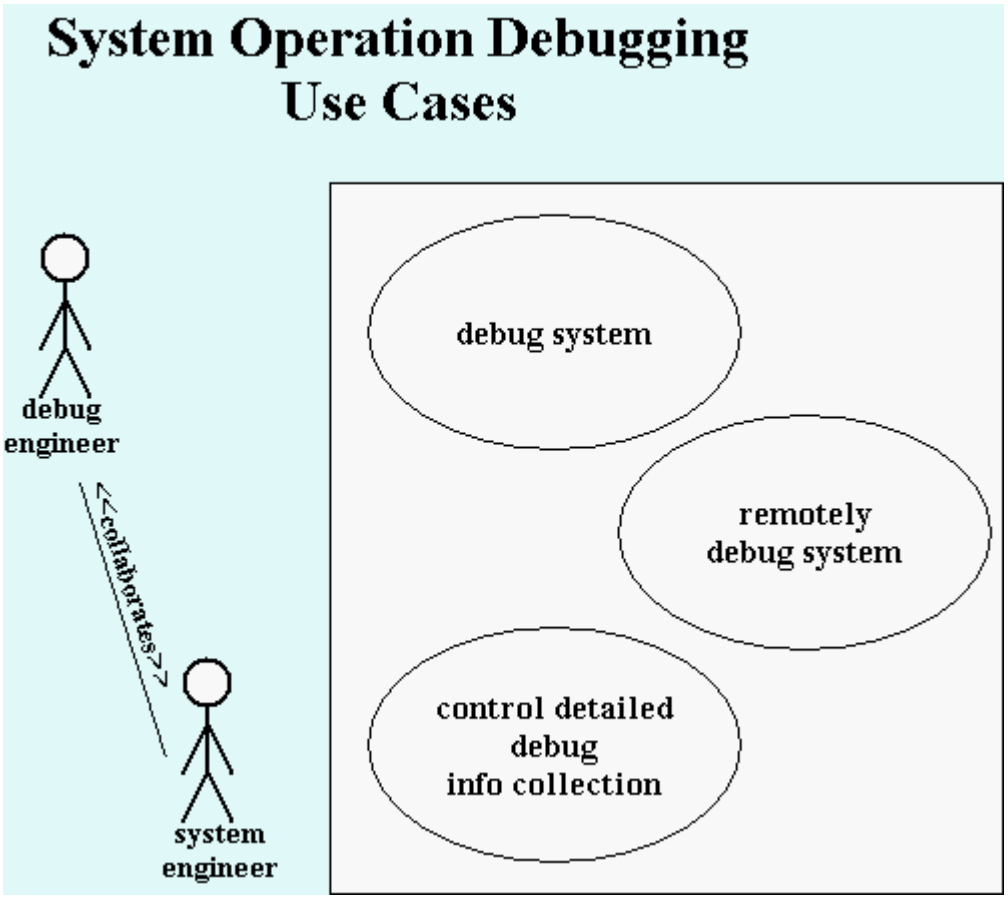
Data obtained from the measurement process may be discarded (not placed in permanent storage), stored in intermediate steps or stored only as the final result. The controlling operator may choose one or more mediums of permanent storage from a selection of mediums that may include SQL relational databases, Object Oriented database, or flat files.



2.3 Reprocessing Use Cases (UC3)

A single controlling operator will handle the reprocessing of data through the measurement system. The operator controls the updating of the data processing configuration (choosing new reduction algorithms) and the starting and ending of the processing itself. The operator also views the intermediate and end results of the reprocessing.

The reprocessed data may be discarded, or stored on one or more mediums of available permanent storage that may include flat files, SQL relational databases, or Object Oriented databases.



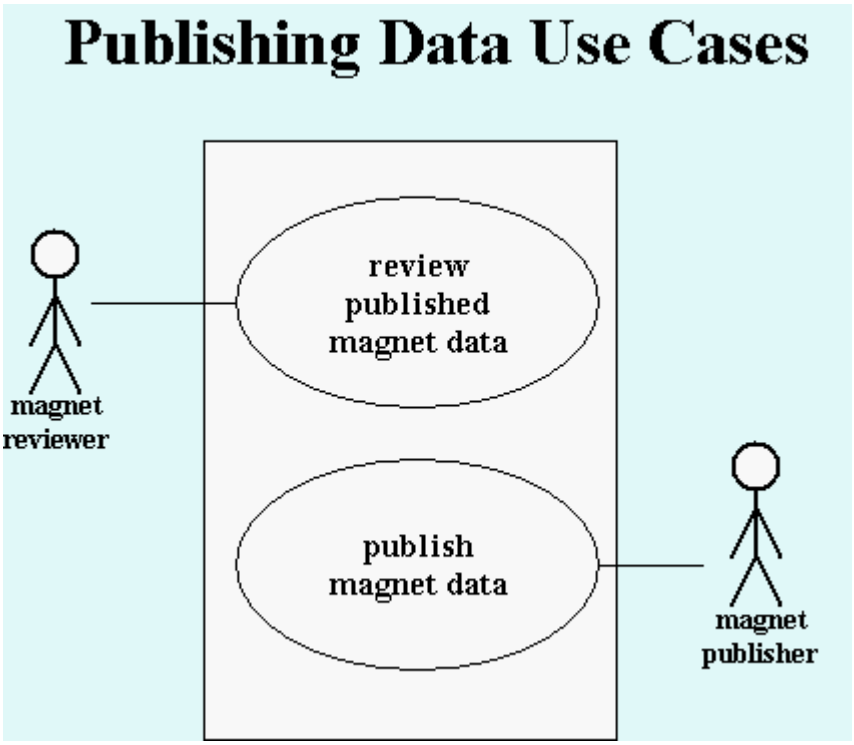
2.4 System Debugging Use Cases (UC4)

A debugging engineer may control certain functions of an operating measurement system for debugging purposes. This includes the starting of a detailed debug trace when deemed necessary, as well as possible interactions with the measurement process. A debug engineer operating in a remote environment will interact with the system operator to enable special debug functions, but not control the whole system.

The debug engineer may save the detailed debugging information to a flat file.

2.5 Publishing Data Use Cases (UC5)

The magnet data publisher will determine the data that best characterizes the magnet and publish this set of data. The magnet reviewer will be able to view this published data.



The published data will be in the form of a web page possibly including plots, data tables, links to flat files of data and documentation pertaining to the measurement and analysis.

3. Functional Requirements

3.1. Core functional requirements

RF 1. acquire data from the sensors (probes...)
RF 2. control measurement hardware (motors...)
RF 3. process acquired data to produce required "reduced data"
RF 4. visualize selected data during processing
RF 5. archive raw and "reduced data"
RF 6. allow reprocessing of data

3.2 Extensibility

RF 7. provide framework to accommodate more than one type of measurement (SSW, harmonics, etc.)
RF 8. ability to modify data processing without rebuilding the system
RF 9. ability to accommodate various visualization required by different processing
RF10. ability to easily define and modify division between on-line and off-line processing

RF11. the system should be "open" (public interfaces, APIs, etc.)
RF12. ability to accommodate other data sources in place of DAQ

3.3 Configurability

RF13. ability to independently configure hardware, measurement, processing, visualization, and data storage
RF14. ability to easily modify configurations
RF15. the system should identify and store configurations
RF16. the system should be able to reuse configurations
RF17. reconfiguration does not necessarily mean that the system has to be restarted (rebooted)

3.4 DAQ

RF18. ability to modify hardware settings "on-the-fly" (without rebooting)
RF19. ability to acquire data from more than one source (DAQ, cryo monitoring, power supply system)
RF20. ability to handle different DAQ acquisition systems/models
RF21. availability of diagnostic functions at all times (not just when errors happen)

3.5 Measurement control

RF22. manual measurement control
RF23. automatic measurement control
RF24. reusable descriptions of automated measurements
RF25. ability to control not only a DAQ subsystem, but also some other separate subsystems in order to setup requested measurement conditions (current control system, positioning system, etc.)
RF26. ability to continue interrupted measurement (for long lasting measurements)
RF27. ability to schedule unattended measurements

3.6 Processing

RF28. ability to easily modify processing to accommodate needs for special tests, serial tests, ad hoc tests, etc.
RF29. information about processing steps should be kept associated with resulting data
RF30. ability to modify: set of processing steps, for each step selection of algorithm to be used, for each algorithm parameters
RF31. accommodate for both "single shot" measurement and "data stream measurement"

RF32. no limit on the measurement time (it means using when appropriate "flow" algorithms instead of "store-and-forward")

3.7 Visualization

RF33. ability to show intermediate results as displays of various types during measuring and processing
RF34. ability to use more than 1 display to show data visualization during the entire measurement process
RF35. ability to print the current display being shown

3.8 Data Archival

RF36. be able to accommodate various data store types (RDBMS, OODBMS, flat files...)
RF37. be able to retrieve data for post analysis
RF38. keep association between data belonging to one measurement (test), including raw data and all processed data
RF39. keep information about currently selected "official" analysis results for a given measurement (raw data set)
RF40. keep associations between all configurations and data
RF41. supply an automated log of activities performed on a set of data

3.9 Data Publishing

RF42. ability to gather various measurements on a subject and publish them to the web including: comments, plots, raw data files, reduced data and explanations added at time of publishing

4. System Requirements

4.1 Throughput

RS 1. there will be various systems such as flatcoil, single stretched wire, etc.
RS 2. rotating coil measurements
256 points per revolution
5 to 10 Hz revolution frequency
8 data items per measured point (1 angle, 1 time, 1 current and 5 flux points)

4.2 Deployment Platforms

RS 3. platform independence (initially: daq- VxWorks, processing - Unix or PC, storage - Unix or PC)

RS 4. ability to use more than one screen for visualization (multicomputer visualization)
RS 5. ability to accommodate connection of real time and non-real time systems (buffering)

4.3 Exception Handling

RS 6. provide error and event logging
RS 7. availability of a special debugging mode for each component
RS 8. self-diagnostics (e.g., processing phase is followed by verification phase)
RS 9. ability to debug remotely
RS10. graceful recovery of system when errors occur (system does not crash)

4.4 User Interfaces

RS11. graphical user interfaces instead of text based dialogues
RS12. ability to connect comments
RS13. web acces to published data
RS14. tools and guidelines will be supplied to create reports

4.5 Access Control

RS15. multiuser system with one controlling operator and multiple monitoring users
RS16. the system will support voluntary identification of the measurement controlling operator
RS17. the system will provide for individual user identification when entering comment