

# Software Engineering Project (2IP40)

Project Group 1

## Software Validation and Verification Plan

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## **Abstract**

This is the Software Verification and Validation Plan (SVVP) for the SPINGRID project. This project is part of the Software Engineering Project (2IP40) and is one of the assignments at Eindhoven University of Technology. The document complies with the SVVP from the Software Engineering Standard, as set by the European Space Agency [ESA]. This document describes the activities concerning the project's verification and validation.

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# Chapter 1

## Introduction

### 1.1 Purpose

This document describes procedures concerning the testing of the delivered products (product documents and software) of the SPINGRID project for compliance with the requirements. The requirements that the software is to be verified against can be found in the product documents [URD], [SRD], [ADD] and [DDD]. The modules to be verified and validated are defined in the AD phase. The goal of verifying and validating is to check whether the software product to be delivered conforms to the requirements of the client and to ensure a minimal number of errors in the software. This project document is written for managers and developers of the SPINGRID project.

### 1.2 Scope

In the SPINGRID project a system has to be designed to support grid-calculations. The software to be made consists of at least three applications, which must interact using the internet. *Dispatchers* gather jobs from various *Submitters* and dispatch them to so called *Agents*. The entire system has to be developed (in JAVA) in a way that it is easy to maintain and extend.

### 1.3 List of definitions

This section contains the definitions of all used terms, acronyms and abbreviations in this document.

2IP40	The Software Engineering Course ID at Eindhoven University of Technology
AD	Architectural Design
Agent	Application that retrieves and executes jobs
ATP	Acceptance Test Plan
CI	Configuration Item
Client	Monitor, Agent or Submitter
Customer	Dutch Space B.V.
CM	Configuration Manager
DD	Detailed Design
Dispatcher	Application that dispatches jobs to Agents
ESA	European Space Agency
Monitor	Application that either monitors dispatchers
PM	Project Manager
QAM	Quality Assurance Manager
SCMP	Software Configuration Management Plan
SM	Senior Management
SPMP	Software Project Management Plan
SQA	Software Quality Assurance
SR	Software Requirements
SRD	Software Requirements Document
Submitter	Application that submits jobs to dispatchers
SVVP	Software Verification and Validation Plan
SVVP/SR	SVVP/Software Requirements
SVVP/AD	SVVP/Architectural Design
SVVP/DD	SVVP/Detailed Design
TR	Transfer Phase
TU/e	Eindhoven University of Technology
UR	User Requirements
URD	User Requirements Document
XML	eXtensible Markup Language



## 1.4 List of references

[ADD]	<i>Architectural Design Document</i> , SPINGRID team, TU/e, Version 1.0.0, April 2006
[ATP]	<i>Acceptance Test Plan</i> , SPINGRID team, TU/e, Version 0.1.0, June 2006
[DDD]	<i>Detailed Design Document</i> , SPINGRID team, TU/e, not yet available
[ESA]	<i>ESA Software Engineering Standards (ESA PSS-05-0 Issue 2)</i> , ESA Board for Software Standardization and Control (BSSC), 1991
[ITP]	<i>Integration Test Plan</i> , SPINGRID team, TU/e, 0.1.0, May 2006
[SCMP]	<i>Software Configuration Management Plan</i> , SPINGRID team, TU/e, 0.1.2, June 2006
[SE1]	Software Engineering Website: Requirements for user requirements <a href="http://wwwis.win.tue.nl/2R690/ur_req.html">http://wwwis.win.tue.nl/2R690/ur_req.html</a> , T. Verhoeff, TU/e, 2002
[SE2]	Software Engineering Website: Reviews <a href="http://wwwpa.win.tue.nl/wstomv/edu/sep/checklists/reviews.html">http://wwwpa.win.tue.nl/wstomv/edu/sep/checklists/reviews.html</a> , T. Verhoeff, TU/e, 2002
[SPMP]	<i>Software Project Management Plan</i> , SPINGRID team, TU/e, Version 0.1.1, January 2006
[SVVP]	<i>Software Verification and Validation Plan</i> , SPINGRID team, TU/e, Version 0.1.3, June 2006
[SQAP]	<i>Software Quality Assurance Plan</i> , SPINGRID team, TU/e, 0.1.3, June 2006
[SRD]	<i>Software Requirements Document</i> , SPINGRID team, TU/e, 1.0.1, March 2006
[STP]	<i>System Test Plan</i> , SPINGRID team, TU/e, 0.1.0, June 2006
[URD]	<i>User Requirements Document</i> , SPINGRID team, TU/e, 1.0.0, February 2006
[UTP]	<i>Unit Test Plan</i> , SPINGRID team, TU/e, 0.1.0, May 2006

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# Chapter 2

## Verification overview

### 2.1 Organization

The SQA team checks the verification and validation of the activities of the SPINGRID project. Therefore a member of the SQA team attends every internal or external review. The QAM reports problems he runs into to the PM. It is the responsibility of the PM that these problems are solved. More about the procedures for reviews can be found in [SE2]. The SPINGRID project uses the following verification and validation activities:

#### 2.1.1 Internal reviews

The team carrying out the internal review of a technical or management document will at least consist of the following persons:

- A member of the SQA team, (preferably) not part of the authoring team
- The team leader of the authoring team
- At least one other member of the SPINGRID team, (preferably) not part of the authoring team
- The advisor can also be present if necessary or feasible

When reviewing a management CI, it is feasible that the PM is also present.

#### 2.1.2 External reviews

An external review can only take place after the document has been approved by the advisor. The external reviews of management documents will be done by the SM. The team carrying out the external review of a technical document will consist of the following roles:

- initiator (makes the appointments etc.)

- moderator: the advisor
- 50 • author(s): of the document to be reviewed. At least the team leader should be present.
- secretary: member of the authoring team (quality engineer)
- reviewers: one or more members of the SPINGRID team and where necessary also the customer

### 55 2.1.3 Audits

Audits are reviews that assess compliance with software requirements, specifications, baselines, standards, procedures, instructions, codes and contractual and licensing requirements. Physical audits check that all items identified as being part of the configuration are present in the product baseline. A functional audit checks that unit tests, integration tests  
60 and system tests have been carried out and records their success or failure. Functional and physical audits can be performed before the release of the software (ESA Software Engineering Standards 4.2.5. Auditing [ESA]). The SM is allowed to audit the SPINGRID project to check if the procedures, as described in the management documents [SPMP], [SQAP], SVVP and [SCMP], are followed. Audits are not routine checks, but the SM can  
65 request them. The following rules apply to all audits:

- Only the SM can request audits.
- Audit requests must be directed to the PM.
- In the audit request the following information must be included:
  - Names of the auditors (at least two persons)
  - 70 – People required to be present
  - Possible dates of the audit
  - Purpose of the audit
  - Items that will be checked
- The audit is attended by a member of the SQA Team (preferably QAM), the PM  
75 and possibly others as indicated by SM.
- The results of the audit are reported in a written report to the PM and the QAM within one week of the audit. This report must contain the following information:
  - Date of the audit
  - Participants in the audit
  - 80 – Checked items
  - Conclusion
  - Recommendations

### 2.1.4 Tests

The testing is done following the ESA Life cycle verification approach [ESA]. The following  
85 test plans (plans that outline the approach to testing) can be found as separate documents:

- Acceptance test plan [ATP]
- System test plan [STP]
- Integration test plan [ITP]
- Unit test plan [UTP]

90 The [ATP] has to be approved by the client.

The results of the tests are presented to the PM and the QAM.

The CIs must also be tested to assure that all the requirements are met. This can be found in Chapter 4.3 Tracing and is documented in the [SVVP/SR], [SVVP/AD] and [SVVP/DD].

## 95 2.2 Schedule

The schedules for all phases are given in the [SPMP].

## 2.3 Resources

A room at the 5th floor of the main building of the TU/e (HG 5.14) is available for the project meetings, internal reviews, external reviews and all other activities concerning the  
100 SPINGRID project. In this room there is at least one PC available. Network (internet) connections are available both wired and wireless. It is also possible to print (A4) documents on a printer close by. The server(s) containing the SPINGRID-documents are permanent accessible from any computer with an internet connection.

## 2.4 Project responsibilities

105 The PM is responsible for the progress of the entire project. He monitors the progress as described in the [SPMP]. The team leader is responsible for the validation of the CIs created by his team (all technical CIs, except the [URD], must have a verification and a validation report attached to it). The leader of the test team is responsible for the verification of the CIs. The SM can check the test procedures and results during an audit.

## 110 2.5 Tools, techniques and methods

The tools that are used during the project are discussed in the [SCMP].

# Chapter 3

## Administrative procedures

### 3.1 Anomaly reporting and resolution

115 Everything that is not up to standards it should be up to or does not conform to requirements it should conform to, is an anomaly. Procedures for anomaly resolution can be found in the [SQAP]. Furthermore, it is the task of the SQA team to monitor whether the procedures as defined in the management plans ([SPMP], [SCMP], [SQAP] and [SVVP]) are followed. This is done during team meetings, reviews and by randomly checking CIs.  
120 Findings are reported to the PM. It then is the responsibility of the PM to enforce compliance with defined procedures. If the results of the PMs actions are not satisfactory to the QAM, he can request the senior management to take further action.

### 3.2 Task iteration policy

Every task performed is to be reviewed as described in chapter 4 (Verification Activities).  
125 If during a review problems are discovered concerning the correct conclusion of the task, a decision is made concerning the iteration of the task. Guidelines for the following cases are:

- The team responsible was unable to complete their task, for example because of a lack of knowledge or manpower. In this case, it is the responsibility of the team leader to solve the problem and make sure the task is completed as described in the [SPMP]. If the team leader is unable to do so, he must report this to the PM and QAM. If problems arise concerning the dependencies between tasks these are to be reported to the PM and QAM.  
130
- A structural error was found in the execution of the task, for example that the output of a piece of code does not comply with the requirements. In this case, the team that is responsible performs the task again. If necessary the PM schedules extra man-hours.  
135

- An item was forgotten during the execution of a task. Depending on the severity of this item, the PM decides whether the entire task or only a part of the task needs to be redone or that no action is taken. In other cases the PM will decide what actions have to be taken. He can consult the QAM if necessary.

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### 3.3 Deviation policy

During the SPINGRID project, the procedures described in the management documents are followed. However, if in the QAM's opinion, this endangers the completion of the project then the QAM can decide to deviate from these procedures. If the decision is made to deviate from the procedures described in the management documents, the PM must be informed of such a deviation.

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### 3.4 Control procedures

Procedures assuring that CIs are not accidentally or deliberately changed are described in the [SCMP].

150

### 3.5 Standards

Before both internal and external reviews, the authors certify that the document is according to [ESA] standard, and that the document complies with the standard layout as detailed in [SCMP].

# Chapter 4

## Verification Activities

### 4.1 Reviews

Review procedures are held during all phases of the SPINGRID project. CIs are reviewed in the phase they are delivered; an overview of which CI is delivered in which phase can be found in the [SPMP]. All project and product documents have one of the following statuses:

- Draft (initial status)
- Internally approved
- Conditionally approved
- Approved

Note that approved technical documents are not modified (unless the completion of the project is endangered). With respect to the approved management documents only appendices, for every phase, are added during the project. The appendices are approved during the progress meetings.

For a document to become (internally) approved it has to be reviewed. Here internal and external reviews of technical and management documents (Chapter 4.1.1 Internal review respectively Chapter 4.1.2 External review) are distinguished. For more information about reviews, see [SE2].

#### 4.1.1 Internal reviews

For the organization of internal reviews see section 2.1.1 (Internal reviews). Here the team leader is the leader of the review and the others are the reviewers. The table below shows the action list for the preparation and execution of the internal reviews of documents.

The QA is the member of the SQA-team present. T is the time of the review meeting.

Nr	Actor	Action	Time
1	QAM/QA	Set a date for the internal review of the document	-
2	Leader	Deliver the paper review version of the document to the reviewers	T - 2 workdays
3	Reviewer	Inspect the document (language errors are underlined)	Before T
4	Reviewer	Discuss all errors other than language errors	T
5	Leader	Write down all necessary changes	T
6	Reviewer	Decide if the document can be approved, provided the stated changes are made	T
7	QA	If the document cannot be approved, an appointment for a new review meeting is made	T
8	Leader	Collect annotated documents	T
9	QAM/QA	See to it that the stated remarks are handled properly by the team delivering the document	After T
10	QAM/QA	Grant the document the status <i>internally accepted</i> if all requested changes are made	After T

### 4.1.2 External reviews

For the organization of external reviews see section 2.1.2 (External reviews). Here the team leader is the leader of the review, and the advisor is the moderator. The table below shows the action list for the preparation and execution of the external reviews of documents. T is the time of the review meeting. The duration of the review is one hour (plus an additional quarter of an hour if necessary). This procedure is only for the external review of technical documents, the external review of management documents is done by the SM. In the case of technical documents, the metrics of the external review will be send to the SM.



Nr	Actor	Action	Time
1	PM	Set a date and place for the external review of the document	After internal acceptance
2	Leader	Deliver the paper version of the document to all reviewers (with a reply address)	T - 5 work-days
3	Reviewer	Inspect the document, and put remarks on paper using the supplied template (see appendix A)	Before T - 2
4	Reviewer	Deliver remarks to the moderator	T - 2 work-days
5	Moderator	Inspect remarks	T - 2 work-days
6	Leader	Lead the meeting and keep discussions to the point	T
7	Secretary	Document everything that is discussed during the review	T
8	Reviewer	Discuss all comments that need explanation or discussion (no time will be spent on language errors and self-explanatory comments)	T
9	Leader	Collect the remarks on the documents	T
10	Reviewer, moderator	Decide the status of the document at the end of the meeting. There are three possible outcomes: <ul style="list-style-type: none"> <li>the document is rejected and a new appointment is made</li> <li>the document is accepted and the status <i>Approved</i> is granted</li> <li>the document is accepted conditionally*</li> </ul>	T
11	Secretary	Make minutes of the review, and hand these together with the remarks of the reviewers to the Senior Management. Also make sure they will go to the configuration management system	T
If the document is not unconditionally accepted (this is the case when the document is <i>rejected</i> or <i>accepted conditionally</i> ) actions 12 and 13 apply. If the document is <i>accepted</i> actions 12 and 13 do not apply.			
12	QAM	See to it that the remarks are handled properly by the team responsible for the document	After T
13	QAM	Grant the document the status <i>Approved</i> if all reviewers inform that their remarks are handled properly	After T
* (this means that it will be accepted when all the changes stated during the review meeting are handled properly. No new review needs to be held. The corrected version of the document is sent to the reviewers as described in action 2 and the reviewers inform about their final acceptance via e-mail)			

## 4.2 Formal proofs

190 Formal proof will be given where considered necessary by the SQA team, or when asked by the person(s) responsible for a certain product.

## 4.3 Tracing

During the SPINGRID project the relation between the input and the output of a phase must be checked several times. A traceability table is included in the validation report, which is added to each product CI (except the URD). In this table the CI is traced to the input of the phase. During the software life cycle it is necessary to trace:

- User requirements to software requirements and vice-versa, this is checked during reviews in the SR-phase and is documented in the [SVVP/SR].
- 200 • Software requirements to component requirements and vice-versa, this is checked during reviews in the AD-phase and is documented in the [SVVP/AD].
- Component requirements to DD requirements and vice-versa, this is checked during reviews in the DD-phase and is documented in the [SVVP/DD].
- Integration tests to architectural units and vice-versa, this is described in the integration test plans. These tests are performed during the DD-phase.
- 205 • Unit tests to the modules of the detailed design, this is described in the unit test plans. These tests are performed during the DD-phase.
- System tests to software requirements and vice-versa, this is described in the system test plans. These plans are executed during the DD-phase.
- 210 • Acceptance tests to user requirements and vice-versa, this is described in the acceptance test plans. These tests are executed during the TR-phase.

To support traceability, all requirements are uniquely identified.

# Chapter 5

## Verification Reporting

For the verification and validation of technical CIs (apart from the [URD]) two parts are  
215 added to these CIs:

- A verification report
- A validation report

These reports are presented to and checked by a member of the SQA team. The people  
performing the test of the CI write the verification report. The people who delivered the CI  
220 write the validation report. These are both checked when the CI is reviewed. A validation  
report is written as a result of the tracing. It contains a traceability table. A verification  
report is written as a result of a test. It contains the following items:

- Unique reference number of the test plan
- Problems discovered and, if available, solutions to these
- 225 • Acceptance or disapproval of the CI. In case of disapproval, accompanied with a short  
explanation of the reasons of disapproval

For the verification and validation of the entire SPINGRID project, progress meetings are  
held with the SM according to the [SPMP].

# Appendix A

## External review

### A.1 Template for remarks

Project:

Document:

Version:

Date:

Reviewer:

Nr.	Ref.	Type	Remark	Severity	Action

**Number** Sequence number of remark starting at 1.

**Ref.** Reference to page/section and line number(s), or “general”

**Type** **M** Missing

**X** Extra/superfluous

**A** Ambiguous

**I** Inconsistent

**U** Improvement desirable (unclear)

**S** Not conforming to standards

**R** Risk-prone

**F** Factually incorrect

**N** Not implementable

**E** Editorial

**Severity** Major or Minor, when in doubt leave open

**Action** Decision about future action:

- No action
- Local change
- Global change
- Investigate

## A.2 Minutes of the review

The minute of the external review must contain the following information:

- When (date and time) was the external review meeting held
- Who were present and which role did they fulfill
- What were the most important subjects of discussion
- A summary of all remarks that are handed in
- A list of decisions and appointments that are made
- The status of the reviewed document

See also [SE2].

# Appendix B

## UR Phase

### B.1 Requirements for user requirements

These are the requirements for the user requirements as defined in [SE1]. User requirements  
270 should be realistic, that is:

- Clear
- Verifiable ("The product shall be user friendly" is not verifiable)
- Complete
- Accurate (Among other things, the URD is inaccurate if it requests something that  
275 the user does not need, for example a superfluous capacity.)
- Feasible

How to obtain good user requirements?

- Clarify the user requirements through criticism and experience of existing software and prototypes.
- Use interviews and surveys to establish wide agreement.  
280
- Use knowledge and experience of developers to decide on implementation feasibility.

In the URD each requirement must...

- ...**have a unique identifier.** Traceability in other phases depends on this identifier.
- ...**be marked essential or not.** Essential requirements have to be met for the  
285 software to be acceptable.
- ...**have a priority** if the transfer will proceed in phases.

- ...**be marked if unstable.** Unstable requirements may depend on feedback from later phases.
- ...**have its source listed.** A document reference or the name of a person or group.
- ...**be verifiable.**

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# Appendix C

## SR Phase

For the second phase of the project (SR), the SQA team must verify the output of the [SRD] against the requirements of the [URD].

### C.1 Traceability tables

As part of the tracing of the [SRD] to the [URD] (and back) two traceability tables are constructed and placed in an appendix of the [SRD]:

- One table tracing each of **the user requirements to a software requirement**. In the first column the user requirements are listed in alphabetical order. In the second column the corresponding software requirements are listed.
- One table tracing each of **the software requirements to a user requirement**. In the first column the software requirements are listed in alphabetical order. In the second column the corresponding user requirements are listed.

This table also shows that one user requirement can be traced to more than one software requirement, and that one software requirement can be traced to more than one user requirements



# Appendix D

## AD Phase

310 For the third phase of the project (AD), the SQA team must verify the output of the ADD against the requirements of the SRD.

### D.1 Traceability tables

As part of the tracing of the [ADD] to the [SRD] (and back) two traceability tables are constructed and placed in an appendix of the [ADD]:

- 315 • One table tracing each of **the software requirements to a component**. In the first column the software requirements are listed in alphabetical order. In the second column the components that implement them are listed.
- 320 • One table tracing each of **the components to the software requirements it implements**. In the first column the components are listed in alphabetical order. In the second column the software requirements that are implemented by them are listed.

# Appendix E

## DD Phase

For the fourth phase of the project (DD), the SQA team must verify the output of the DD  
325 against the ADD.