ECSS-M-10B

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EUROPEAN COOPERATION

*E*CSS

FOR SPACE STANDARDIZATION

Space project management

Project breakdown structures

ECSS Secretariat
ESA-ESTEC
Requirements & Standards Division
Noordwijk, The Netherlands

ECSS

Foreword

This Standard is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications. ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards.

Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this Standard takes into account the existing ISO 9000 family of documents.

Significant changes between this version and the previous version are:

- unique numbering of each requirement, and

- a new clause on "Project organization breakdown structure".

This Standard has been prepared by the ECSS Management Standards Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board.

This version B cancels and replaces ECSS-M-10A.

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Introduction

As a part of the ECSS Management standards, this Standard defines specific requirements for the project breakdown structures for space projects.

The content of this ECSS Standard is coherent with the widely known and used processes for preparing and managing the different structures of projects in many fields of activity throughout the world.

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Scope

This ECSS Standard is part of a set of ECSS Standards belonging to the management branch.

In order to create the reference system for project management necessary for implementation of a project and ensure consistency, the project is broken down in a unique, orderly and exhaustive manner, to allow unambiguous identification of the associated products and models, as well as the tasks and resources necessary.

This Standard defines the principles to be respected for setting up, using and adapting the breakdown structures and implementing them in a project.

The requirements specified herein apply to and affect the supplier and customer at all levels.

When viewed from the perspective of a specific project context, the requirements defined in this Standard should be tailored to match the genuine requirements of a particular profile and circumstances of a project.

> NOTE   Tailoring is a process by which individual requirements of specifications, standards and related documents are evaluated and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.
> [ECSS–M–00–02A, clause 3]

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Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the publication referred to applies.

ECSS-P-001   Glossary of terms

ECSS-M-20   Space project management — Project organization

ECSS-M-60   Space project management — Cost and schedule management

ECSS-E-10-02 Space engineering — Verification

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Terms, definitions and abbreviated terms

3.1   Terms and definitions

For the purposes of this Standard, the terms and definitions given in ECSS-P-001 apply.

3.2   Abbreviated terms

The following abbreviated terms are defined and used within this Standard:

Abbreviation	Meaning
CBS	cost breakdown structure
OBS	organization breakdown structure
WBS	work breakdown structure
WP	work package

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Principles for creating the project breakdown structures

4.1 Basic principles

The project breakdown structures are derived from the first level customer's requirements, starting from the functional requirements. These functional requirements can be presented in the form of a function tree. Then the process goes through product tree elaboration, which is the exhaustive definition of the system elements. Delineating the tasks needed to develop and produce an element leads to the work breakdown structure. The identification of cost categories facilitates the establishment of the cost breakdown structure (CBS). The allocation of the WBS to the industrial organization results in the business agreement structure and definition of the interfaces.

The project breakdown structures provide the basis for:

- creating a common understanding between the various participants by attributing unique item identifications and definitions as well as defining the associated tasks and resources;

- unambiguously identifying the responsibilities of individuals within the organization for performing the work;

- co-ordinating and optimising the necessary resources and performing the tasks;

- enabling a structured definition, production and verification of documents for

  - identification of all the tasks to be performed,

  - identification of all the interfaces and their management,

  - effective management of the configuration,

  - management of changes, and

  - management of risks.

The established trees are characterized by:

- a summit (zero level), and

- levels of breakdown into elements.

Breaking the project down into manageable elements, including interfaces, facilitates effective risk management.

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4.2 Function tree

The function tree is the structure resulting from breakdown of the system performances into functions.

Each function can be decomposed into sub-functions, so making a "tree", independent of the type of products involved.

The "function" approach is applied during project start-up or during the system definition phase.

The function tree leads to the product tree, by translating functions into specifiable hardware and software products.

4.3 Product tree

The product tree is the breakdown of the system into successive levels of hardware and software products or elements, based on the functions identified.

The product tree is the basis for the work breakdown structure and is agreed between the actors prior to business agreement and is baselined at business agreement.

The product tree creation starts after the functional structure of the final product has been identified.

The products identified in the product tree include as a minimum

- items submitted to customer configuration control, and
- items that are the subject of a technical specification.

Each supplier then completes the product tree at their own level for the products under their responsibility.

4.4 Identification of models: model matrix

The implementation document for project phasing and planning (e.g. development plan) documents the model philosophy applied to the various products making up the system.

In relation to the product tree, therefore, an additional breakdown is obtained depending on the types of models used. The model philosophy can be expressed in the form of a matrix defining, for each element on the product tree, the various models to be applied.

4.5 Work breakdown structure (WBS)

The WBS is the principal structure used in managing a project. The WBS defines the scope of the work. It is based on the analysis of all the management, product assurance and engineering tasks. For each element on the function tree and product tree, it is determined which tasks shall be performed and the required resources. These tasks are identified by one or more work breakdown structure elements.

The WBS is

- the basis for identifying the necessary resources;
- the basis for comparing bids and business agreement negotiations;
- the definition of the work packages necessary for project management;
- the basis for project schedule and cost planning and management;
- the definition of all the technical interfaces and other relationships within the project during the overall life cycle; and
- a support for the development of the documentation and specifications hier-archies.

The work of each supplier is explicitly identified in the work breakdown structure by at least one work package (WP).

Typically a WP is any element of the WBS down to the lowest level agreed between the actors. The actual level of control is agreed between the actors at the time of business agreement.

A work package has the following characteristics:

- it is measurable and manageable in its scope to allow planning, monitoring, and controlling of progress;
- it is allocated to only one WP manager;
- it is defined by a "work package description";
- it results in supply of products or documents, corresponding to accomplishment of the task of the WP;
- it identifies all "inputs" and "outputs", including interfaces with other tasks or WPs;
- it clearly identifies planning constraints;
- it is uniquely identified.

4.6   Other structures

4.6.1   Cost breakdown structure

The cost breakdown structure (CBS) defines cost elements in terms of agreed cost categories to be used for cost control, and uses the WBS for cost summarization.

Where ECSS–M–60 cost categories alone are not sufficient, they are extended to include the contractor's own categories, as agreed by the customer.

4.6.2   Business agreement structure

The business agreement structure represents the hierarchy of business agreements of the project. The business agreement structure is related to the WBS. This facilitates financial control from a contractual viewpoint.

The business agreement structure is used to allocate interface responsibilities.

4.6.3   Project organization breakdown structure

The project organization breakdown structure (OBS) depicts the proposed project organization, including the interface and contractual responsibilities, as opposed to company organization breakdown structure, which depicts the functional aspects of the company. The project OBS shows the key personnel and the assigned responsible parties for each work package in the WBS.

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Requirements

5.1 General

In this ECSS Standard, in order to facilitate reading, tailoring and traceability, the requirements are listed according to numbered topics. Often an explanatory text, such as the aim of the requirement or the expected output (text in italics), is attached to the numbered requirement.

In applying the principles described in clause 4, the following subclauses define the requirements, that shall be fulfilled.

5.2 Function tree

Based on customer inputs and contract negotiations, the supplier shall prepare the function tree for his workshare.

AIM: Define the structure of the system in terms of its functions.

EXPECTED OUTPUT: *A function tree.*

5.3 Product tree

5.3.1

Based on customer inputs and contract negotiations, each supplier shall develop the product tree for all his products down to the deliverable end items, and incorporate the product trees of lower tier suppliers.

AIM: Define the structure of the system in terms of its elements (e.g. subsystems, equipment, and assemblies).

5.3.2

a. The product tree shall be subject to customer approval.

AIM: Provide an approved working base between all the actors.

b. The supplier shall maintain the product tree up-to-date under configuration control.

AIM: Ensure that all the modifications in services or in requirements agreed between the actors are taken into account.

EXPECTED OUTPUT: *An up-to-date product tree approved by the customer.*

5.4   Model matrix

5.4.1

a.   Based on customer inputs and contract negotiations, the supplier shall establish a model matrix describing the applicability of models to each element on the product tree taking ECSS–E–10–02 into consideration.

AIM: Identify models in relation to the product tree.

b.   The model matrix shall be consistent with the project planning and phasing data (e.g. development plan).

5.4.2

a.   The model matrix shall be subject to customer approval.

b.   The supplier shall maintain the model matrix up-to-date under configuration control.

AIM: To trace changes in the project planning and phasing data (e.g. development plan).

EXPECTED OUTPUT: *An up-to-date model matrix approved by the customer.*

5.5   Work breakdown structure (WBS)

5.5.1

Based on customer inputs, contract negotiations, and the approved product tree, each supplier shall develop the WBS for his workshare in the project and incorporate the WBSs of lower tier suppliers.

AIM: Establish the principal structure for managing the project.

5.5.2

a.   Work related to manufacturing, assembly, integration and test shall be shown in the WBS, in relation to the models.

AIM: To ensure proper identification of the manufacturing, assembly, integration and test work required for each model.

b.   Engineering work shall be identifiable in connection with its related product tree elements such as system, subsystem or unit level.

AIM: To ensure proper identification of the work required for engineering

c.   Work related to management, product assurance and any other support activities (e.g. procurement) shall be shown in the WBS.

AIM: To ensure proper identification of the work required for support activities.

5.5.3

a.   The WBS shall be subject to customer approval.

AIM: Provide an approved working base between all the actors.

b.   Each supplier shall maintain the WBS for his workshare in the project up-to-date.

AIM: Ensure that all the modifications in services or requirements agreed between the actors are taken into account.

EXPECTED OUTPUT: *Up-to-date and approved WBS, covering all work required to fulfil the contract.*

5.5.4

a.   Each work package identifier shall be unique.

b.   The rules for identification of each WP shall be specified by the first level customer.

c.   The rules for identification of each WP shall be followed by each actor.

5.5.5

Each WP shall have a single responsible WP manager (a WP manager may be responsible for several WPs).

5.5.6

a.   The supplier shall describe the content of each work package shown in his WBS.

b.   The WP descriptions shall be agreed between the actors.

EXPECTED OUTPUT: *Set of WP descriptions agreed between the actors.*

5.5.7

The WP description shall address the following subjects:

- project name and project phase;
- WP title;
- unique identification of each WP in line with the identification rules required by 5.5.4 and issue number
- supplier or entity in charge of the WP performance;
- WP manager's name and organization;
- supplier's country (when political or economic constraints exist);
- product to which the tasks of the WP are allocated (link to the product tree);
- description of the objectives of the WP;
- description of the tasks;
- list of the inputs necessary to achieve the tasks;
- interfaces or links with other tasks or WPs;
- list of constraints, requirements, standards, and regulations;
- list of the expected outputs;
- list of deliverables;
- location of delivery;
- start event identification including date;
- end event identification including date;
- excluded tasks.

EXPECTED OUTPUT: *Up-to-date and approved WBS, covering all work required to fulfil the contract.*

5.6 Other structures

5.6.1 Cost breakdown structure (CBS)

a. The supplier shall implement a CBS.

b. Based on customer inputs and contract negotiations the supplier shall specify the cost categories for resources, including labour, equipment, and facilities, taking ECSS–M–60 into consideration.

c. The supplier shall expand the cost categories for resources in the form of a CBS.

d. The supplier shall keep the CBS up-to-date.

AIM: Provide the framework for summarizing cost.

EXPECTED OUTPUT: *An up-to-date CBS.*

5.6.2 Business agreement structure

a. The first level supplier shall provide a business agreement structure associated with the WBS.

b. The first level supplier shall provide a geographical and company/contract breakdown, based on contracts awarded, or to be awarded.

AIM: Facilitate financial control from a contractual viewpoint and define interfaces responsibilities.

EXPECTED OUTPUT: *The business agreement structure.*

5.6.3 Project organization breakdown structure (OBS)

a. The supplier shall establish a project OBS taking ECSS–M–20 in consideration.

b. The project OBS shall be submitted to the customer for approval.

c. The supplier shall maintain the approved project OBS, keep it up-to-date, and issue it to the lower tier contractors and the customer.

AIM: To indicate project responsibilities and their hierarchical relationships in the project context.

EXPECTED OUTPUT: *Project OBS.*

Annex A (informative)
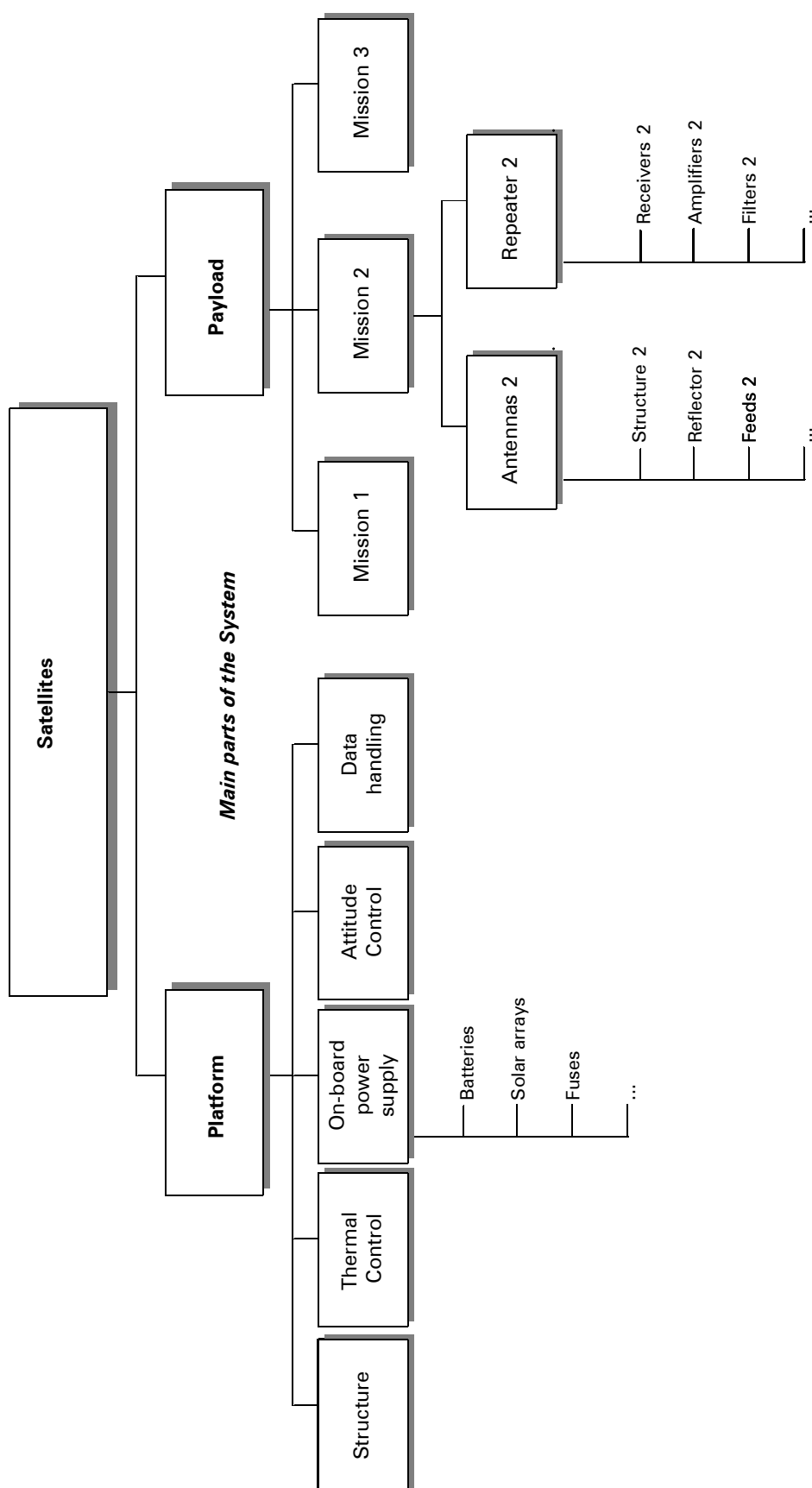
Product tree (example)

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Figure A‑1: Example product tree

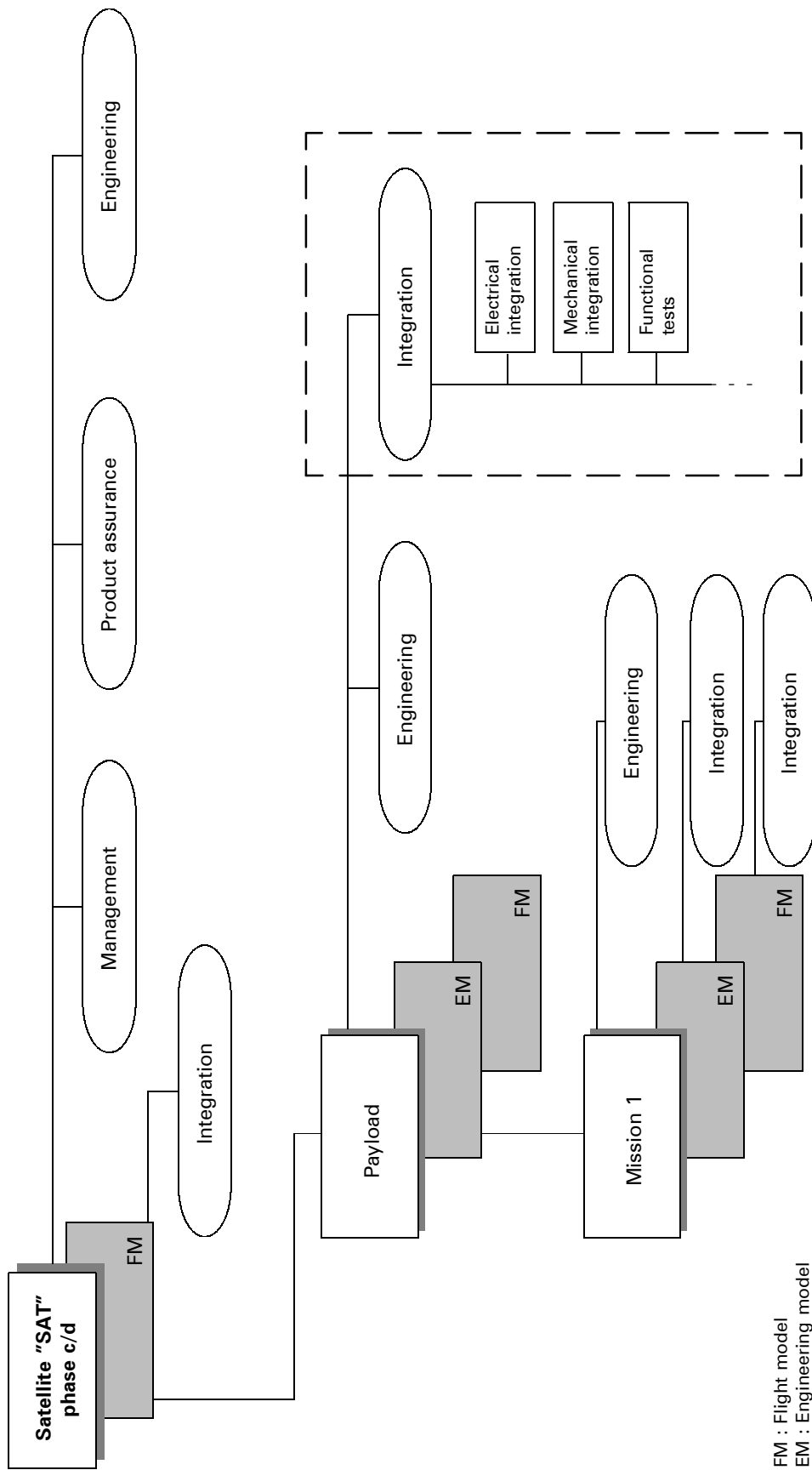# Annex B (informative)

Work breakdown structure (example)

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Figure B-1: Example work breakdown sheet

FM : Flight model
EM : Engineering model

ECSS Document Improvement Proposal

1. Document I.D. ECSS–M–10B	2. Document date 13 June 2003	3. Document title Project breakdown structures
4. Recommended improvement (identify clauses, subclauses and include modified text or graphic, attach pages as necessary)		
5. Reason for recommendation		
6. Originator of recommendation		
Name:	Organization:	
Address:	Phone: Fax: e-mail:	**7. Date of submission:**
8. Send to ECSS Secretariat		
Name: W. Kriedte ESA-TOS/QR	Address: ESTEC, P.O. Box 299 2200 AG Noordwijk The Netherlands	Phone: +31–71–565–3952 Fax: +31–71–565–6839 e-mail: Werner.Kriedte@esa.int

Note: The originator of the submission should complete items 4, 5, 6 and 7.

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