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SDU-502 - Instruction for developing process descriptions in SR-PSU

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1 Introduction

This document contains instructions for the development of process descriptions in the SR-PSU.

The main activities of the work with development of the SR-PSU process descriptions are listed below with reference to other sections of this document for more information. These main activities are:
1. Review/establish a set of variables and their definitions for a system component (see Section 3.2)
2. Review/establish list of processes for a system component (see Section 3.3)
3. Develop process descriptions (see Section 3.4)
4. Check and document handling of FEPs and matrix interactions (see Section 4.1)
5. Finalise process descriptions (see Section 4.2).

Definitions

System component – physical component of the repository system, that is a sub-system.
Variable – physical parameter or entity that is required to describe the properties and conditions in a system component.
Process – radiation, thermal, hydraulic, mechanical, chemical and biological process, or group of related processes, acting within the repository system.

2 Objective and scope

The overall objective of this instruction is to ensure that all FEPs identified as processes and judged as relevant in the FEP analysis are included in the process reports and described according to a predefined format. The instruction also ensures that the handling of the processes is documented in a structured way.

The instructions in this document are focusing on activities related to the development of process descriptions and are directed to the editor and experts responsible for the development of the process descriptions in the SR-PSU assessment.

The instructions are applicable for the process reports covering the waste, the engineered barrier system components and the geosphere, i.e. for the following reports:
- Waste process report for the safety assessment SR-PSU
- Barrier process report for the safety assessment SR-PSU
- Geosphere process report for the safety assessment SR-PSU.

For the SR-PSU climate report, entitled Climate and climate-related issues for the safety assessment SR-PSU, the instructions are applicable for the descriptions of the climate-related processes that have a direct impact on the repository system.

These instructions are not intended for use in the development of descriptions of biosphere processes, except for the part of the instruction regarding the check and documentation of handling of FEPs and matrix interactions (section 4.1).

3 The SR-PSU process reports

3.1 Information sources

Some examples of information sources are:
- the SR-Site process reports /SKB 2010b, SKB 2010c, SKB 2010d/,
- the SR-Site Climate report /SKB 2010e/,
- the reference evolution in the SAR-08 main report /SKB 2008b/,

- The FEP reports of SAR-08 /SKB 2008a/ and SAFE /SKB 2001/.
- The FEP table (see Section 4.1) that may be provided to the author from the editor.

In addition to the above sources, existing documented scientific/technical knowledge shall be used. To the extent possible the author should refer to the open literature and peer-reviewed articles and documents.

3.2 Variables and definitions

For each system component, a set of variables and definitions of these variables are defined. These variables and definitions must be followed by all experts producing process descriptions for a certain system component. Later modifications are allowed, but must be communicated to and approved by the editor and the SR-PSU FEP team.

3.3 Review/establishment of process lists

The SR-PSU FEP team is responsible for providing provisional process lists for all system components defined for SR-PSU. These lists must be reviewed by the editor, with the assistance of the appropriate experts if needed. Modifications are allowed, but must be communicated to and approved by the editor and the SR-PSU FEP team.

3.4 Structure and content of process descriptions

All processes shall be documented using the template for the SR-PSU process descriptions (developed for SR-Can/SR-Site process descriptions). This template contains the following headings:

1. Overview/general description
2. “Dependencies between process and xxxx variables”, where xxxx is the name of the system component
3. Boundary conditions
4. Model studies/experimental studies
5. Natural analogues/observations in nature
6. Time perspective
7. Handling in the safety assessment
8. Handling of uncertainties
9. Adequacy of references supporting the handling in SR-PSU
10. References

One general requirement on the content under headings 1 to 6 is that the text should provide the basis for the arguments and documentation under heading 7 of the selected handling of the process in SR-PSU. It should also be the basis for the arguments and documentation of how uncertainties are handled in SR-PSU under heading 8. Further instructions and explanations regarding the content under the different headings are given below.

3.4.1 Overview/general description

Under this heading, a general description of the knowledge regarding the process shall be given. The focus of the description shall be to provide a general framework for the process. This framework can be later used when discussing the selected handling in SR-PSU and the handling of uncertainties that are documented under separate headings. The section may also include a description that directly support the selected handling in SR-PSU.

3.4.2 “Dependencies between process and xxxx variables”, where xxxx is the name of the system component

This section contains a tabulated overview of how the process is influenced by a specified set of variables in the relevant system component and how the process influences these variables.

This is exemplified in Table 3-1. The following text concerns this particular format but other formats are allowed as long as the included content complies with the below description.

In the first column "Variable", the defined variables for the system component in question are listed.

In the second and third columns the influences of the variables on the process are outlined. In the second column, the answer to the question "Does this variable influence the process?" shall be answered by Yes or No and a short specification of the influence can be given. If the answer is Yes, a short indication how the influence is handled shall be given in the third column. If it is not handled, the reason to this shall be stated here. This may also be expanded upon below the table and in the section "Handling in the safety assessment".

In the fourth and fifth columns the influence of the process on the variables are outlined by answering the question "Does the process influence this variable?" by Yes or No in column four and by giving comments to this in column five. This may also be expanded upon below the table and in the section "Handling in the safety assessment".

Table 3-1. Direct dependencies between the process "xxxx" and the defined xxxx variables and a short note on the handling in SR-PSU.

Variable	Variable influence on process		Process influence on variable	
	Influence present? (Yes/No) Description	Handling of influence (How/If not - Why)	Influence present? (Yes/No) Description	Handling of influence (How/ If not - Why)

The purpose of this table is to show the couplings between processes and physical variables that describe the state of the system and thereby also how processes are coupled via these variables.

Note: It is only direct dependencies between variables and processes that shall be included in the table with a Yes. Otherwise processes might be short-circuited. Indirect dependencies might be given, but then it must be clearly indicated, for example as "No, but indirectly through".
Note: Preparing the table with couplings between variables and a process shall also be seen as a review of the existing set of variables for a system component and their definitions. Modifications are allowed, but must be communicated to and approved by the editor and the SR-PSU FEP team.

3.4.3 Boundary conditions

Under this heading, the boundary conditions for each process shall be described and discussed. This may include

- Boundaries between system components (outer boundaries)
- Boundaries within system components (internal boundaries)

For example, the system component geosphere has several outer boundaries – the interface to the biosphere, the geosphere outside the repository system, the interface to repository parts. The internal boundary can be exemplified by the interface between fractures and the surrounding rock matrix.

The processes for which boundary conditions need to be described are, in general, related to transport of matter or energy across the boundaries.

3.4.4 Model studies/experimental studies

Model and experimental studies of the process are summarised. This may refer to tasks performed within SKB site investigations, site descriptive modelling, and safety assessment (e.g. SAFE, SAR-08, SR-Site) but also in other scientific areas.

3.4.5 Natural analogues/observations in nature

Natural analogues and/or observations in nature of the process are described under this heading. If there are no relevant analogues/observations to describe, this is stated in the text.

3.4.6 Time perspective

The time scale or time scales on which the process occurs is documented, if such timescales can be defined. If it cannot be defined, this shall be stated. Example of time scales may be:

- repository saturation phase,
- periods of different climate domains,
- years, centuries, millenia, entire repository evolution (100 000 years),
- during certain bounding temporal condition (costal or inland, lake formation stages, after barrier degradation…).

3.4.7 Handling in the safety assessment

Here the handling of the process in SR-PSU is described and arguments for the selected handling are documented. Aspects that may be discussed are:

- how influences between variables and process are handled,
- handling of process in respect to relevant time periods for the system component,
- how couplings to other processes are handled,
- how boundary conditions are handled.

3.4.8 Handling of uncertainties

Under this heading, different types of uncertainties associated with the selected handling of the process in SR-PSU shall be described. These uncertainties are described under the following subheadings. In addition to these subheadings, a short summary of input data uncertainty may be given.

Uncertainties in mechanistic understanding
The uncertainty in the general understanding of the process should be discussed based on the preceding documentation and with the aim of answering the question: Are the basic scientific mechanisms behind the process sufficiently well understood? If the answer is no, the handling of this uncertainty must be described. Alternative models may sometimes be used to illustrate this type of uncertainty.

Model simplification uncertainty
In most cases, the quantitative representation of a process will contain simplifications. These may result in a significant source of uncertainty in the description of the system evolution. The handling of this uncertainty should be discussed. Alternative models or alternative approaches to simplification for a particular conceptual model may sometimes be used to illustrate this type of uncertainty.

3.4.9 Adequacy of references supporting the handling in SR-PSU

Under this heading, statements are provided concerning the adequacy of the references in a quality assurance perspective. These statements are restricted to the references supporting the selected handling. According to the distinction made in SDU-115, supporting references are documents that are used to support or justify a decision, selection or treatment (handling) of an issue, whereas general references are those used in a broader sense to exemplify or describe an issue. If the handling directly

relies on an older SKB document, or external document, which has not undergone a factual and quality review, the following instruction should be consulted:

- SDU-115 Qualification of the old references SR-PSU.

In most cases, this is not applicable and either of the following the standard phases may be used:

- "The references are judged to be adequate and sufficient to support the handling in SR-PSU. All supporting references are either peer-reviewed articles or documents which have undergone factual review."
- "The references are judged to be adequate and sufficient to support the handling in SR-PSU. Based on the general references, sufficiently extensive arguments for supporting the handling in SR-PSU are given in this process report".

3.4.10 References

In the final process reports, all references will be compiled in one separate chapter. However, in order to simplify the preparation of the reference list **it is requested that full references are provided at the end of each process description** in every draft version of the process descriptions.

4 QA-procedures

4.1 Handling of FEP tables and matrix interaction tables

An audit of the SR-PSU processes against the NEA FEP database and against the content of the SKB Interaction matrices utilised in SAR-08 will be carried out as a part of the FEP work in project SR-PSU. This will result in FEP tables and matrix interaction tables. In the FEP tables, NEA FEPs are linked to SR-PSU processes. In the matrix interaction tables, interactions are linked to SR-PSU processes. In the FEP work the audit is carried out by generalists and no attempt is made at this stage to judge the importance of the FEPs or interactions for repository evolution.

The FEP tables need to be checked by the editors/experts developing the process description for two purposes:

1. To screen out NEA FEPs that are not relevant/of low importance for a process.
2. To ensure that relevant NEA FEPs are addressed/covered by the process description.

The FEP tables will be documented in the final version of the SR-PSU FEP database and in the SR-PSU FEP report. To obtain this, the results of these checks have to be documented by the editors/experts preparing the process descriptions in the FEP tables. A similar work was documented in the SR-Site FEP report /SKB 2010a/. The editor of each process report is responsible for this documentation.

A similar procedure involving check and documentation shall be carried out for matrix interactions linked to the processes. The editor of each process report is responsible for this documentation. This work will be documented in the FEP database.

4.2 Documentation of experts and decisions

The final version of a process report shall contain a documentation of which expert(s) assembled the basic information on the process.

5 References

SKB, 2001. Project SAFE. Scenario and system analysis. SKB R-01-13, Svensk Kärnbränslehantering AB.

SKB, 2008a. Project SFR 1 SAR-08. Update of priority of FEPs from Project SAFE, SKB R-08-12, Svensk kärnbränslehantering AB.

SKB, 2008b. Safety analysis SFR 1. Long-term safety, SKB R-08-130, Svensk kärnbränslehantering AB.

SKB, 2010a. FEP report for the safety assessment SR-Site. SKB TR-10-45, Svensk Kärnbränslehantering AB.

SKB, 2010b. Buffer, backfill and closure process report for the safety assessment SR-Site, SKB TR-10-47. Svensk Kärnbränslehantering AB.

SKB, 2010c. Geosphere process report for the safety assessment SR-Site, SKB TR-10-48. Svensk Kärnbränslehantering AB.

SKB, 2010d. Fuel and canister process report for the safety assessment SR-Site, SKB TR-10-46. Svensk Kärnbränslehantering AB.

SKB, 2010e. Climate and climate related issues for the safety assessment SR-Site. SKB TR-10-49, Svensk Kärnbränslehantering AB.

SDU-115 Qualification of old references SR-PSU

Register of revisions

Version	Date	Content of revision	Made by	Reviewed by	Approved by
1.0	2009-08-27	New document	Maria Lindgren	Anna Gordon	Fredrik Vahlund
2.0	2012-03-13	Major revision to better instruct the work, based on experience from SR-Site and on-going SR-PSU work	Maria Lindgren, Martin Löfgren	See header	See header
3.0	2015-07-03	Minor editorial changes and adjustments to actual approach	See header	See header	See header