

## Internal information

## Instruction

Document ID 1082127	Version 1.0	Status Approved	Reg.no	Page 1 (9)
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Reviewed by Allan Hedin			Reviewed date 2008-07-01	
Approved by Olle Olsson			Approved date 2008-07-03	
Case			Valid from	
Reference			Valid until	
Supplement			Replacement	

# INSTRUCTION FOR DEVELOPING PROCESS DESCRIPTIONS IN SR-SITE AND SR-CAN

APPENDIX 2 to 1064228 – Quality assurance plan for the safety assessment SR-Site

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# 1. Introduction

This document contains instructions for the development of process descriptions in the projects SR-Can and SR-Site.

The main activities that were part of the work with development of the SR-Can 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 physical variables and their definitions for a system component (see Section 4.2)
2. Review/establish list of processes for a system component (see Section 4.3)
3. Develop process descriptions (see Section 4.4)
4. Check and document handling of FEPs and matrix interactions (see Section 5.1)
5. Finalise process descriptions (see Section 5.2)

The main activities that are part of the work of updating the SR-Can version to the SR-Site version of the process descriptions are described in Section 3 where also references are given to the applicable SR-Can instructions.

# 2. Objective and scope

The overall objective of the instructions contained in this document is to ensure that all FEPs in the SKB FEP database identified as processes in the FEP handling are considered in the assessment, that the handling is documented in a structured way and that those judged as relevant are included in the process reports and described according to a predefined format.

The instructions in this document are focussing on activities related to the updating/development of process descriptions and are directed to the experts responsible for the updating/development of the process descriptions in the SR-Site assessment. They were developed for, and first applied in, the SR-Can project. The same instructions are in general also valid for any further development that will be undertaken in SR-Site.

The instructions are applicable for the process reports covering the engineered barrier system components and the geosphere, i.e. for the following reports:

- Fuel and canister process report for the safety assessment SR-Site
- Buffer and backfill process report for the safety assessment SR-Site
- Geosphere process report for the safety assessment SR-Site

For the SR-Site climate report, entitled Climate and climate-related issues for the safety assessment SR-Site, 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 applicable for the development of descriptions of biosphere processes.

The instruction for check and documentation of handling of FEPs and matrix interactions (section 3.5) is, however, also applicable for updating/development of descriptions of biosphere processes and of external factors and should also be followed by the experts assigned for that task.

The procedure for assignment of experts is described in a separate document (SKBdoc ID1096716, in preparation).

## **3. The SR-Site process reports**

### **3.1 General**

The point of departure for the work with the SR-Site process reports is the SR-Can versions of these reports and the results from auditing Project FEPs in the NEA FEP database, versions 1.2 and 2.1 /NEA 1999 and 2006/.

The main objective of the work with process descriptions in SR-Site is to update the descriptions included in the SR-Can reports and to develop descriptions for processes related to system components that were not treated in detail in SR-Can. The main activities that are part of the work with development of the SR-Site 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 physical 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/update process descriptions (see Section 3.4)
4. Check and document handling of FEPs and matrix interactions (see section 3.5)
5. Documentation of experts and decisions (see Section 3.6)

### **3.2 Review/establishment of variables and definitions**

For each system component, a set of variables and definition of these variables are defined. For system components included in the SR-Can process report, the variables and definitions are already reviewed and established (see Section 4.2). For system components not previously included in a process report, variables and definitions are to a large extent adopted from the other system components. The lists of variables for system components not previously included in process reports and their definitions must be reviewed by the assigned experts developing the process descriptions according to the procedure described in Section 4.2.

### **3.3 Review/establishment of process lists**

The list of processes in the SR-Can process reports shall be reviewed in order to identify any need for adding, removing or combining processes. The editors of the different process reports are responsible for this activity and for consulting editors of other reports concerning modifications that may impact the structure of other process reports. The editors of the process reports are also responsible for communicating the results of the review and potential updates in terms of a revised process list for each process report to all process report editors and to the project manager.

For system components not specifically treated in SR-Can, provisional process lists are exported from the SKB FEP database. The manager of the SKB FEP database is responsible for providing these lists. These process lists shall be reviewed by the experts involved in developing process descriptions for the system component in question following the SR-Can procedures set up for establishing the process lists, see Section 4.3.

For the SR-Site climate report, the variables for the influence tables are directly derived from the geosphere report.

### **3.4 Develop/update process descriptions**

A template for process descriptions was developed in SR-Can. This template and the requirements on the contents under each heading are described in Section 4.4. The same template shall be used for SR-Site process descriptions, with one exception. The modification in the template concerns heading 1 - Overview/general description, and is described below.

As in the SR-Can template and with the same requirements on the text, a general description of the knowledge regarding the process shall be given under the heading “Overview/general description” (see Section 4.4.1). However, the influence table included under this heading in the SR-Can template shall in the SR-Site version be placed under a separate heading on the same level and named “Dependencies between process and xxxx variables”, where xxxx is the name of the system component. Furthermore the structure of the table is revised and the new structure is shown in Table 3-1 together with an example of table heading. Requirements on the content in the different columns of the table are described below.

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

In the second and third columns the influence of the variables on the process are documented. 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 description how the influence is handled shall be given in the third column. If it is not handled, the reason to this shall be stated.

In the fourth and fifth columns the influence of the process on the variables are documented in the same way as described above.

**Table 3-1. Direct dependencies between the process “Heat transport” and the defined geosphere variables and a short note on the handling in SR-Can.**

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)

### 3.5 Check and document handling of FEPs and matrix interactions

The handling of NEA Project FEPs and Matrix interactions linked to SR-Can processes, as documented by the experts developing process descriptions in the SR-Can process reports according to the procedure described in Section 5.1, are documented in the SR-Can version of the FEP database /SKB 2006/. Tables containing this information are exported from the SKB FEP database to digital word documents by the SKB FEP database manager (see separate document with instructions for development of the SKB FEP database SKBdoc ID1082126). These documents are delivered to the assigned experts for review and, where needed, update of the SR-Can documentation, as well as for documentation of the handling of NEA Project FEPs that are new in the version 2.1 of the NEA FEP database. In addition, the documentation of the handling of matrix interactions that are missing in the SR-Can version of the SKB FEP database is completed.

Updating this documentation follows the SR-Can procedure as documented in Section 5.1 and in a separate document with instructions for development of the SKB FEP database SKBdoc ID1082126.

### **3.6 Documentation of experts and decisions**

The expert(s) that assembled the basic information on the process and the expert(s) that were involved in the decision regarding treatment in the safety assessment shall be documented in the final version of the process report. This is the responsibility of the editor of the process report and is preferably done in a table included in the introductory chapter of the process report. The procedure for assignment of experts is described in a separate document (SKBdoc ID1096716, in preparation). Decisions regarding the handling of processes in SR-Site are the responsibility of the experts in the SR-Site team, based on the assembled basic information on the process. These decisions and the justifications behind are documented in the section "Handling in the safety assessment SR-Site".

## **4. The SR-Can process reports**

### **4.1 Information sources**

The main information source for developing the process descriptions for SR-Can is the SR 97 process report /SKB 1999/. The content of this report is transferred to a SR-Can structure for process descriptions (see Section 4.4).

A second source is the results from auditing Project FEPs in the NEA FEP database, version 1.2 /NEA 1999/. These results comprise documents listing all NEA FEPs that have been linked to processes in the different system components and documents with descriptions of these NEA FEPs as they are described in the NEA Project FEP register (see separate document with instructions for development of the SKB FEP database SKBdoc ID1082126).

A third source is the results from auditing the SKB Interaction Matrix documentation that comprise lists of matrix interactions linked to processes in the different system component and documents with descriptions of these matrix interactions (see separate document with instructions for development of the SKB FEP database SKBdoc ID1082126).

In order to be able to describe the couplings between processes and variables and the boundary conditions for the process, the definition of the system components and the variables of a system component are needed. The existing versions of these definitions are provided in a separate document. More extensive descriptions of the engineered barrier system components are given in the interim SR-Can initial state report /SKB 2004a/.

In addition to the above sources, existing documented scientific/technical knowledge shall be used.

### **4.2 Review/establishment of variables and definitions**

For each system component, a set of variables and definition of these variables are defined. For system components included in the SR 97 process report, the variables and definitions are essentially the same as in the SR 97 process report. For system components not previously included in a process report, variables and definitions are to a large extent adopted from the other system components.

These "draft" versions of variables and definitions must be reviewed by all experts producing process descriptions for a certain system component and a consensus on the set of variables and their definitions must be reached in an early stage of the work. Later modifications are allowed, but must be communicated to and approved by all other experts producing process descriptions for the same system component.

### 4.3 Review/establishment of process lists

“Draft” process lists are provided for all system components defined for SR-Can. These lists must be reviewed and updated by the experts producing the process descriptions. Should there be a need to remove a process from the list (i.e. the unlikely action of completely removing it from the process report), all FEPs and matrix interactions linked to this process must be checked and either be linked to another process or screened out as not relevant or of small importance for the evolution of the system. A motivation for such a judgment must be given. All this shall be documented in the tables developed for documentation of handling of FEPs and matrix interactions (see Section 5.2).

### 4.4 Structure and content of process descriptions

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

1. Overview/general description
2. Boundary conditions
3. Model studies/experimental studies
4. Natural analogues/observations in nature
5. Time perspective
6. Handling in the safety assessment SR-Can
7. Handling of uncertainties in SR-Can
8. References

One general requirement on the content under headings 1 to 5 is that the text should provide the basis for the documentation under heading 6 of the selected handling of the process in SR-Can and the argument for the selected handling as well as for the documentation of how uncertainties are handled in SR-Can under heading 7. Further instructions and explanations regarding the content under the different headings are given below.

#### 4.4.1 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 support the selected handling in SR-Can and the handling of uncertainties that are documented under separate headings.

This section also contains a table for documentation of how the process is influenced by a specified set of physical variables in the relevant system component and how the process influences these variables. These variables are listed in the first column of the table.

In the second and third columns the influence of the variables on the process are documented. In the second column, the answer to the question “Does this variable influence the process” shall be answered by Yes or No. In the third column comments to the Yes or No in the second column can be documented. For example, a variable can influence the process, but the influence is negligible compared to the influence of other variables. These types of judgments are documented in the third column.

In the fourth and fifth columns the influence of the process on the variables are documented 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.

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. From this table it is possible to generate different types of graphic illustrations of these couplings, e.g. Process diagrams that were used in the SR 97 Process Report or interaction matrices.

**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.

Below the table, a short description of the coupling between the variables and the process can be given, for example one paragraph text for each variable.

**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 only according to a defined procedure (see Section 4.2).

#### **4.4.2 Boundary conditions**

Under this heading, the boundary conditions for each process shall be described and discussed. The boundary here refers to the boundary of the system part. The system part geosphere has several boundaries – the interface to the biosphere, the geosphere outside the repository system, the interface to the repository tunnels and other cavities with their backfill and the interface to the buffer in the deposition holes. Other system parts, like the canister, have few boundaries.

The processes for which boundary conditions need to be described are, in general, related to transport of material or energy across the boundaries. For processes occurring inside a system component, e.g. chemical processes like sorption, conditions at the system boundary are not directly relevant, only indirectly via transport processes. For these processes, this fact is stated.

#### **4.4.3 Model studies/experimental studies**

Model and experimental studies of the process are summarized. SR 97 versions are updated with more recent studies.

#### **4.4.4 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.

#### **4.4.5 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.

#### **4.4.6 Handling in the safety assessment SR-Can**

Here the handling of the process in SR-Can is described and arguments for the selected handling are documented. This is done for the relevant time periods defined for each system component. Essentially, this means that the content of the “Handling tables” already developed for each system component shall be described and complemented with arguments for the handling based on the descriptions in the previous sections.

Other aspects that shall be documented here are:

- How boundary conditions are handled
- How influences between variables and process are handled
- How couplings to other processes are handled

#### **4.4.7 Handling of uncertainties in SR-Can**

Under this heading, different types of uncertainties associated with the selected handling of the process in SR-Can shall be described. These uncertainties are described under the following subheadings.

### **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 understood? 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. Alternative models or alternative approaches to simplification for a particular conceptual model may sometimes be used to illustrate this type of uncertainty.

### **Input data and data uncertainty**

The set of input data necessary to quantify the process shall be documented. The further treatment of important input data and input data uncertainties will be described in the Input Data Report, to which reference should be made if relevant.

## **4.4.8 References**

In the final process reports, all references (at least for each system component) will be compiled in one separate Chapter. The present templates (at least for geosphere processes) are structured according to this. 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 the same format as adopted for the SR 97 references in the template** in every draft version of the process descriptions. If a reference from SR 97 is still relevant, copy this reference from the Reference chapter in the template and paste it at the end of the process description for which it is referenced.

# **5. QA-procedures applied in the SR-Can assessment**

## **5.1 Handling of FEPs and matrix interactions linked to a process**

An audit of the SR 97 process report against the NEA FEP database with Project FEPs and against the content of the SKB Interaction matrices utilized in SR 97 were carried out as a part of the SR-Can interim work. This resulted in lists of FEPs and matrix interactions linked to processes. This work is documented in a FEP database and in the SR-Can interim FEP report /SKB 2004b/.

The audit of NEA FEPs was carried out by generalists and no attempt was made at this stage to judge the importance of the FEPs for repository evolution. Therefore, the FEPs linked to processes need to be checked by the experts developing the process description for two purposes:

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

The handling of each FEP will be documented in the final version of the SR-Can FEP database. To obtain this, the results of these checks have to be documented by the experts preparing the process descriptions in tables developed for this purpose.

A similar procedure involving check and documentation of the check shall be carried out for matrix interactions linked to the processes.



## 5.2 Documentation of experts and decisions

The final version of a process description shall contain a documentation of which expert(s) assembled the basic information on the process, and which expert(s) were involved in the decision regarding treatment in the safety assessment.

## 6. References

**SKB, 1999.** SR97. Processes in the repository evolution. SKB TR 99-07, Svensk Kärnbränslehantering AB.

**SKB 2004a.** Interim initial state report for the safety assessment SR-Can. SKB R-04-35, Svensk Kärnbränslehantering AB.

**SKB, 2004b.** Interim FEP report for the safety assessment SR-Can. SKB R-04-32, Svensk Kärnbränslehantering AB.

**SKB, 2006.** FEP report for the safety assessment SR-Can. SKB TR-06-20, Svensk Kärnbränslehantering AB.

## Register of revisions

Version	Date	Content of revision	Made by	Reviewed by	Approved by
1.0	See head of first page	New document	Kristina Skagius-Elert	Allan Hedin	Olle Olsson