

BENTO buffer development program in Finland - key issues

J. Autio¹, L. Korkiala-Tanttu³, M. Vähänen², K. Koskinen², P. Korkeakoski², K. Haapala²

1. B+Tech Oy, Laulukuja 4, FI-00420 Helsinki, Finland (jorma.autio@btech.fi)

2. Posiva Oy Olkiluoto, 27160 Eurajoki, Finland)

3. Pöyry Finland Oy, Jaakonkatu 3, PL500, 01621 Vantaa, Finland

Posiva launched a programme, BENTO, to develop technology of using bentonite in spent nuclear fuel repositories. The main purpose of the BENTO programme is to produce buffer designs and verify that they fulfil the requirements, especially safety requirements. To achieve this objective, resources and the level of expertise and know-how has to be increased. There are several uncertainties related to the functioning of the buffer components at present. If there are enough doubt that buffer system will not fulfil the requirements because of some issue, that issue is defined as being significant. The significant issues need to be resolved in order to develop a proper design and to verify the fulfilment of the requirements. The list of significant issues may change with time. Therefore it is crucial to develop adequate expertise, know-how and laboratory facilities to manage the changes. Moreover, there is confidence that by solving the open issues a defensible construction license application can be submitted in 2012.

The basic nature of the programme is a combination of material and process research with the design (Figure 1) and manufacturing of buffer components to produce feasible buffer design with proven long-term functional properties.

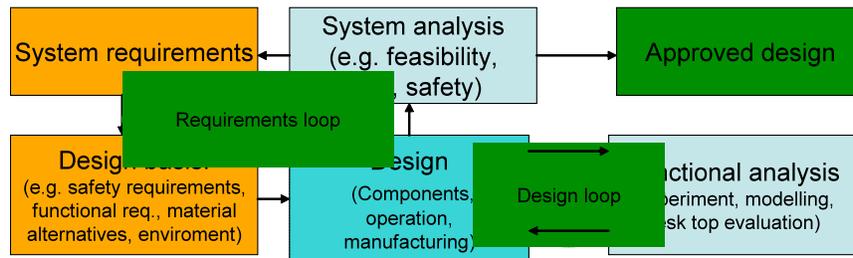


Figure 1: Design process.

The structure of the programme

The development work carried out under BENTO-programme has been initially divided into four different projects. During the course of work the number of projects and their content can be adjusted.

The four BENTO projects are:

1. MANUFACTURING (MANU)
2. DESIGN (DESI)
3. MODELLING (MODE)
4. MATERIAL AND PROCESS RESEARCH (MARE)

BENTO programme aims at producing feasible buffer designs which fulfil the requirements specified in Posiva's requirement management system. The designs are produced in DESI-project by following the design development scheme which starts from specification of design basis and ends in documented detailed designs and therefore DESI is specified as one key project in the programme. Another key part of development is the manufacturing of buffer components (MANU project), which is responsible of the manufacturing of buffer components for testing and final use in the repository. MANU covers the whole chain of events from raw material acquisition and management to manufacturing and emplacement of the final bentonite products. The development of design and manufacturing requires significant amount of

research in order to define the processes that take place during buffer's lifespan from manufacturing to actual buffer function in deposition hole and evaluation of buffer performance. These processes need to be understood in order to define the essential design parameters that affect these processes. Therefore material research (MARE project) is essential requirement for successful design development. Modelling (MODE project) provides support for all other projects. It requires significant resources, comprehensive understanding of different modelling methods and approaches, intense supervision and coordination.

The key questions and objectives

The key RTD tasks related to bentonite in the upcoming TKS period are to describe the initial state and the future behaviour of the bentonite buffer in sufficient detail for the purposes of assessing the long-term safety of disposal. The first key question is the definition of the buffer requirements and the buffer design. The objective is to first specify the required buffer properties, design the buffer that fulfils the requirements and to develop and describe the production of the buffer and its quality assurance in order to describe the initial state of the buffer (after the production).

The second key question is the definition of the buffer's assumed initial state in the Base Scenario and the related technical design requirements. The objective is that the initial state of the buffer conforms to the design requirements and that the subsequent evolution results in the fulfilment of the performance targets (target state). However, the initial state involves uncertainties. In order to reduce them, a better understanding of the buffer itself and its interface with the host rock is needed. The initial state, the related uncertainties and possible deviations depend on the design solutions and implementation of the repository.

The third key question concerns the buffer evolution from the initial state towards the defined target state and to define the bounding scenarios for transport and other essential properties for the buffer. There are a number of processes that are relevant for the buffer performance from the point of view of evolution (long-term performance) and migration and retention properties.

Significant issues

The significant issues are issues, which have been identified by the BENTO programme group to be possibly significant for performance of the buffer. They are as follows:

- Buffer cementation
- Buffer mineral alteration
- Erosion of buffer
- Piping of inflows through the buffer
- Insufficient swelling pressure of the buffer in dry drift sections, effect on rock spalling
- Post-glacial erosion (loss of buffer from exposure to glacial melt waters)
- Cement-bentonite interaction
- Iron-bentonite interaction
- Freezing and Thawing of buffer

Timetable and Outcomes

The BENTO programme started in 2008 and it will be closed by the end of 2012.

The outcome of BENTO programme work will mainly be presented as document deliverables as Posiva Reports or memorandums. Also BENTO workshops will be arranged in annual basis. In addition, the development of these products will result in the creation of new experimental and personnel resources.