E.ON Kernkraft's view regarding the necessary steps for a successful commissioning of the emplacement of radioactive waste in the final repository Konrad-mine-10415

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ABSTRACT

E.ON Kernkraft is the largest nuclear utility in Germany. E.ON Kernkraft is operating six nuclear power plants and owns shares in five other plants in Germany. The radioactive waste is currently stored locally on the power plant sites as well as in central interim storage facilities (i.e. Gorleben, Mitterteich). For the disposal of all German low and medium active waste the Konrad ore mine is foreseen. The Konrad mine is expected to start operation in 2014 and about ten thousand cubic metres of radioactive wastes should be delivered to the final repository annually. This presentation deals with the preparations, which are necessary to start the disposal of radioactive waste.

INTRODUCTION

E.ON´s view regarding the nuclear back-end – despite the European idea and the fact that E.ON is an international nuclear operator – is focused on Germany. All disposal activities for our German nuclear power plants (NPP) are national activities. Since the early 80´s, the German Government pursues a so-called "two-repository-approach": one repository for high-level waste (Gorleben salt mine) and a second repository for low and medium active waste with negligible heat generation (Konrad ore mine).

This presentation will focus only on the disposal of low and intermediate level waste at the final repository Konrad-mine, which will (hopefully) start operation in 2014.

Seventeen nuclear power plants are currently in operation in Germany supplying 30 % of national electricity. Most of the units are large reactors with more than 1,000 MWe capacity.

E.ON is the largest nuclear power operator in Germany. We operate six NPP in Germany and have minority stakes in five further reactors in Germany. Furthermore E.ON is managing two reactors that are currently being dismantled. So E.ON´s share of the total waste volume which will be disposed of at the Konrad-mine is 25 %.

Table 1: Overview on E.ON Kernkraft

Nuclear Power Plants in operation: (6 managed by E.ON Kernkraft, 5 with minority stakes)	**11**
Generation capacity (net. / incl. stakes):	**14.348 MW**
Power Generation (net. / incl. stakes):	**95,4 bn. kWh**
Availability of Nuclear Power Plants:	**91,6 % ***
Employees:	**2.801**

* Nuclear Power Plants managed by E.ON Kernkraft

The operation and the decommissioning of NPP produce - in addition to the spent fuel - low and intermediate level waste. This includes, for example, contaminated clothing, cleaning materials, tools, machine components, concentrated effluents, resins, filters, and others. Since the beginning of the use of nuclear energy, this type of waste has been accumulating. Today, a typical German NPP produces 50 to 60 m^3 (1770 to 2120 cu.ft.) of low and intermediate level waste – conditioned for the disposal - per year.

The decommissioning of a NPP will create 5,000 to 6,000 m^3 (177.000 to 212.000 cu.ft.) of conditioned low and intermediate level waste. This operational and decommissioning waste is normally stored at reactor sites or in two centralized storage facilities that are available for all German utilities.

To date the German utilities have a stock of 30.000 m^3 (1 Mio. cu.ft) of low and intermediate level waste. In addition to this quantity, the public nuclear research centers have around 100 000 m^3 (3.500.000 cu.ft).

In each NPP exists an interim storage facility. In addition to these facilities' the German NPP can use two further centralized interim storage facilities for low and interim level residues at Gorleben and Mitterteich.

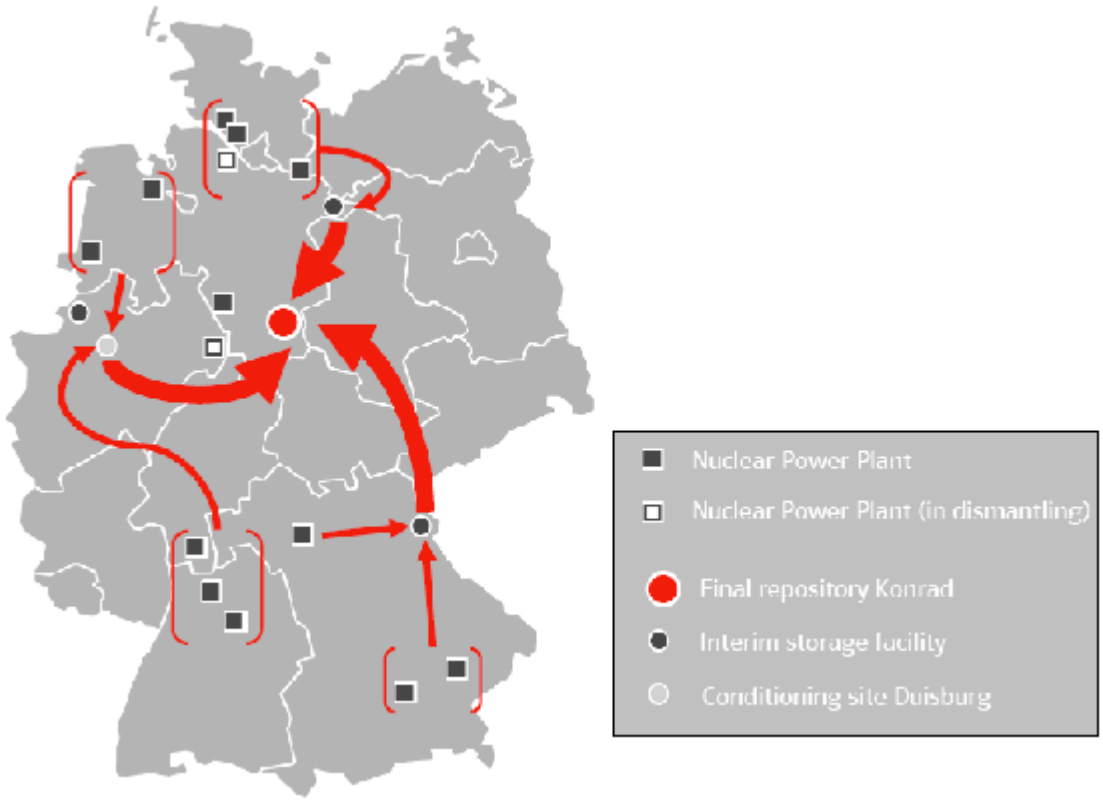

Fig. 1: Transport streams NPPs ⇒ Conditioning sites ⇒ Final repository Konrad

The German waste disposal concept

In Germany, the issue of waste disposal was already under consideration when the use of nuclear energy was developed. In 1963, the Federal Government already issued a recommendation to use rock salt formations for radioactive waste disposal. In 1973, the planning for a national repository started, and in 1976, the Atomic Energy Act was amended to assign the responsibility of such disposals to the Federal Government.

Between 1992 and 1994, all German utilities used the former East-German final repository Morsleben (Saltmine, former final repository for East-German Nuclear power plants) to dispose of 25,000 m^3 (880.000 cu.ft) of low-level waste.

Konrad

In Germany, a repository - the Konrad ore mine - has been under investigation since 1982.
The plan-procedure (licensing), initiated according to the law in 1982, was concluded in 2002 with the plan-approval decision delivered by the Lower Saxonian Environmental Ministry. This plan-approval application

provides for the disposal of radioactive waste with negligible heat generation, which represents about 90 % of the amount of waste altogether in Germany.

The total waste package volume for Konrad is limited to 303,000 m^3 (10 Mio. cu.ft.) in the licensing decision and is exclusively for German needs. This volume takes into account the residual operating lives of the NPP of max. 32 years stipulated in the consensus agreement of 2001.

Fig. 2: License package volume for Konrad repository

According to the agreement between the Federal Government and the utilities of June 6, 2001, (with respect to the phase-out of nuclear energy) BfS as the applicant withdrew its application for an immediate execution of the plan-approval decision in July 2000. Claims filed by communities and individuals thus delayed the execution of the license. With its decision of March 8, 2006, the Lüneburg Higher Administrative Court dismissed the claims and did not admit a revision at the Federal Administrative Court. All claimants filed complaints against the non-admittance of the revision. The complaints were dismissed by the Federal Administrative Court (BVerwG) on April, 2007. The legal remedies of administrative jurisdiction have thus been exhausted. A legal and unappealable plan-approval decision for the Konrad repository is now available.

During the summer 2007, the BfS established the "Construction of Konrad Repository" project group. This group coordinates the conversion of the Konrad mine into a repository. The actual conversion of the Konrad mine into a repository will take about four years. Thus, in total a period of about six years must be assumed until disposal of radioactive waste can start in the Konrad mine; i. e. disposal operations could start in 2014.

How E.ON is prepared?
The waste management organization in the headquarters in Hanover includes the following departments: waste management, decommissioning and dismantling, radiation protection and materials logistics (General Procurement). These departments and their respective counterpart at the nuclear power plants ensure an optimal planning and management of nuclear waste. Furthermore, a dozen cooperation teams are working together, consisting of staff from the power plants, the headquarters and the GNS. The GNS is utility-owned company which is carrying out most of all conditioning campaigns in the NPP. These cooperation teams engage in the preparation for the disposal of the radioactive waste.

In each Nuclear Power Plant of E.ON Germany, one department is responsible for the management of the waste disposal. This department handles the specific waste-conditioning campaigns, which are usually carried out by

external companies. The objective is to have a conditioned waste – now called residue – which fulfils the disposal requirements of repository Konrad.

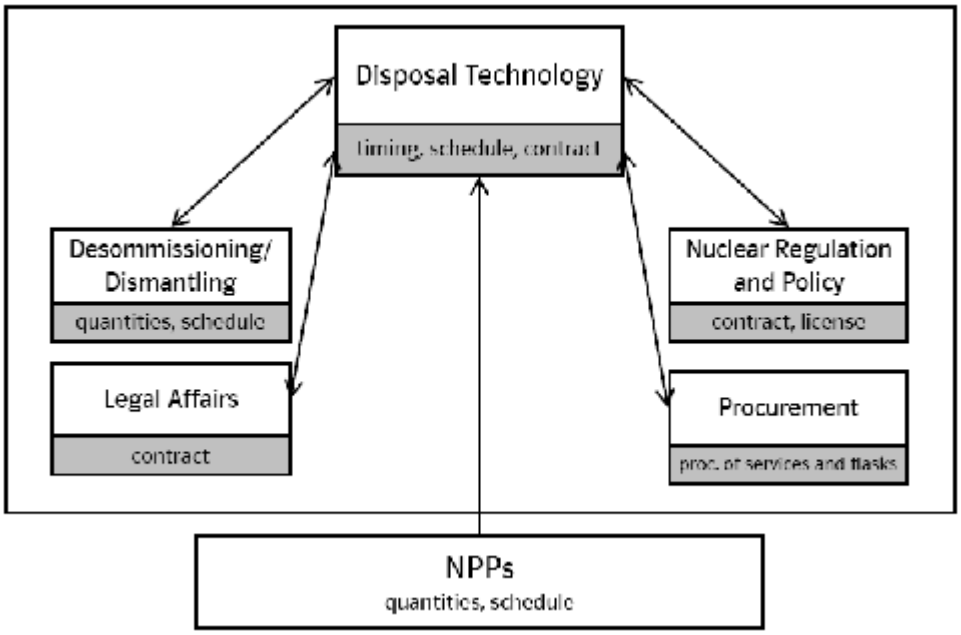

Fig. 3: Responsible Departments at EKK-Headquarter

In the E.ON Kernkraft headquarters, the responsible departments optimize the back-end across all the eight nuclear power plants. The departments concerned with disposal and decommissioning are supported by commercial and law departments.

Which problems have to be solved before we can emplace radioactive waste?

Issue No. 1:
Disposal requirements
The BfS - as the operator of the repository - announced that the actual disposal requirements will be revised in 2010. For this reason the residues already conditioned and "ready for disposal" has only a conditional acceptance by BfS. Therefore a lot of risks exist like changing the documentation and the re-conditioning of residues. To be prepared for a fast and intensive use of the repository, E.ON wants long lasting and binding disposal requirements.

Issue No. 2:
One of the greatest challenges we see is the license issued under Water Law permission:
One very specific item of the Konrad repository is the license issued under Water Law permission which includes several conditions. The additional requirements based on the water law license and it's licensing conditions have to be fulfilled since the license was finally unappealable in 2007. These aspects are not included in the acceptance requirements for Konrad mine, which were published in 1995 but have to be fulfilled since the license is unappealable. These additional requirements will be finally implemented in the above mentioned revised disposal requirements in 2010.

The background for this license issued under Water Law permission is that in addition to the disposal of the radioactive waste, also the chemical and hazardous substances in the waste packages must be taken into account. These chemical and hazardous substances are parts of the waste, the matrixes, and the containers (material and coating). It is assumed that these chemical and hazardous substances will be mobilized after 300,000 years and

have adverse effects on the ground water. For all above mentioned substances which are part of the waste packages it has to be shown that there will be no adverse effects on the groundwater.

Due to the license, the disposal requirements will determine the maximum amount of chemical and hazardous substances for 94 groups of substances that can be emplaced and have to be balanced if the inventory of the package exceeds the declaration limits. Insignificant non-detectable amounts of substances do not have to be balanced as long as the declaration limits are not exceeded. For chemical and hazardous substances that are not listed it has to be shown that there are only insignificant amounts and therefore no adverse effects on the ground water have to be assumed.

material	**max. amount for disposal**
γ-Hexachlorcyclohexan (Lindan)	1.72 g
Biphenyle (PCB)	1.72 g
platinum	10.30 g
quicksilver	43.70 kg
Na-EDTA	21,000.00 kg
chrome	80,000.00 kg
lead	33,400,00.00 kg
iron	632,000,000.00 kg

Table 2: Example of chemical and hazardous substances (list)

In November 2009, the Federal Office for Radiation Protection presented a draft of the procedures to determine and balance an account (for) the chemical and hazardous substances. From the utilities' point of view, this procedure is not practicable and will create an enormous effort for the utilities, the conditioning process, and the experts. We therefore see this draft procedure very critically.

Issue No. 3:

Waste container for the Konrad repository

The preliminary repository conditions request specific waste containers for handling, transport, and emplacement, which are described in detail in the preliminary repository conditions. There are eleven basic containers, which can be cylindrical or block-shaped.

Container and Vessels for intermediate and final storage

Type **Steel**	L mm	W mm	H mm	gross volume m^3
Container type I	**1,600**	**1,700**	**1,450**	**3.9**
Container type II	**1,600**	**1,700**	**1,700**	**4.6**
Container type III	**3,000**	**1,700**	**1,700**	**8.7**
Container type IV	**3,000**	**1,700**	**1,450**	**7.4**
Container type V	**3,200**	**2,000**	**1,700**	**10.9**
Container type VI	**1,600**	**2,000**	**1,700**	**5.4**
Cast iron				
Container type VI	**1,600**	**2,000**	**1,700**	**5.4**

Fig. 4: Container

Type	Dimension ∅ mm	W mm	H mm	gross volume m^3
Concrete type I	**1,060**	**1,060**	**1,370**	**1.2**
Concrete type II	**1,060**	**1,060**	**1,510**	**1.3**
Cast iron type I	**900**	**900**	**1,150**	**0.7**
Cast iron type II	**1,060**	**1,060**	**1,500**	**1.3**
Cast iron type III	**1,000**	**1,000**	**1,240**	**1**

Fig. 5: MOSAIK

Before we can emplace our residues, it has to be proven that the containers are consistent with the guidelines provided by the Federal Office for Radiation Protection. Parts of this qualification procedure to get the so-called package approval are
Drop tests,
Thermal test (fire)
Handling tests
Stacking tests.
In addition to these disposal certificates, the well-known general transport and the site-specific interim storage requirements also have to be fulfilled.
Only a small number of all existing containers have received the necessary approvals by the Federal Office for Radiation Protection. For the majority of packages, this package approval has yet to be applied for. One of the great challenges that the waste producer are facing is the get these approvals before the opening of the Konrad repository.

Issue No. 4
Documentation and declaration
Each waste package has to have an extensive documentation file, in which a detailed description of the origin of the raw waste, the conditioning method, the activity and the content of non-radioactive but chemical-toxic matter has to be listed.
To improve the documentation process and to decrease the amount of files for the waste documentation the documents which will be the same should be placed over in one superior document, which is valid for a class of waste or conditioning procedures.
The procedure for the declaration of the chemical-toxic matter is not finalized. The German utilities cannot finish the whole waste conditioning and treatment process for the waste as long as there is no final procedure for this.

Issue No. 5:
Logistics and preparation facility
As mentioned earlier our waste or residues are storied in different places around Germany. An optimized solution for the loading / emplacement of the Konrad repository would be a large logistics and preparation facility right next to the Konrad repository. With such a facility, additional transports (to and from a conditioning facility) could be reduced. Unfortunately, this central solution is not feasible, mostly due to the fact that it is not possible to buy the relevant premises, as the owners refuse to sell. In addition the relevant authorities would not support the idea of such a facility right next to the repository because of further social impacts for the region.

Outlook:

As mentioned above, a lot of problems have to be solved before the emplacement of waste at the Konrad repository can be started. As one of the greatest challenge for the utilities we see the water admission. We fear

that this admission will cause a lot of enormous conditioning treatments, declarations (balancing) and numerous peer assessments.

In spite of the enormous expenses and efforts necessary for all the a. m. issues, EKK is expecting the emplacement operation without any further complications to start in 2014.

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