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TSO Activities in Licensing and Supervision Procedure during the Construction, Operation and Dismantling of the Vitrification Facility Karlsruhe

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1. Introduction: The nuclear fuel reprocessing plant (WAK) was built from 1967 to 1970 by the research center at Karlsruhe as a pilot plant for commercial reprocessing at Wackersdorf. From 1971 to 1990, about 200 tons of nuclear fuels had been reprocessed. Operating experiences were gained for the development of commercial reprocessing plant. In 1991 German government made the decision to drop out of the reprocessing technology. Since 1991 WAK is going to be dismantled through 6 steps corresponding to 6 decommissioning licenses completely to "green field".

During the reprocessing phase of WAK about 60 m^3 of high active waste concentrate (HAWC) solution had stored in the storage building (LAVA) of WAK from 1971 to 1990. Before the decommissioning and dismantling of the storage building of WAK HAWC had to be disposed. In order to condition HAWC from reprocessing to a waste product for final repository storage, the Vitrification Facility Karlsruhe (VEK) was build near the high-level waste storage building. From December 1997 the nuclear regulatory authority in Baden-Württemberg authorized TUEV SUED ET to assess the safety design and quality control measures for the conceptual design, construction, operation, decommissioning and dismantling of VEK to assure that the precaution measures against the damage are sufficient. The aim is to avoid unallowable enhanced releases of radiological substances to the atmosphere during normal and abnormal operation and under accident conditions caused by internal or external events. Various recommendations on safety requirements were provided by TUEV SUED ET in the expertise to concept, construction and operation of VEK.

The vitrification process was developed by the Institute for Nuclear Waste Disposal at Karlsruhe Institute for Technology [1]. The vitrification process takes place in a ceramic melter at approx. 1200 ^{0}C. The glass product is filled into stainless steel canisters. Each canister is filled with a total of 400 kg glass in four sittings. After cooling, the canisters are weld shut and cleaned outside, before they are stored in transport and storage canisters of CASTOR type.

Five separate licenses were granted for construction and operation of VEK. The last license has been granted in February 2009 for radioactive operation. 140 canisters with 56 t of waste glass in total were produced.

2. TSO Activities in licensing and supervision procedure during the construction, operation and dismantling of vitrification facility Karlsruhe: In the beginning of nuclear technology in Germany the authorities engaged TUEV as technical experts (TSO) based on their activities for conventional (non-nuclear) technical facilities. Since then TUEV enlarged its competence in all topics of nuclear safety and radiation protection.

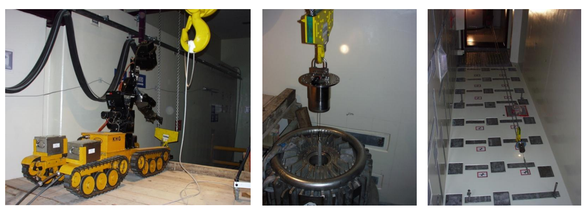
The licensing structure of VEK: For construction and operation five separate licenses are granted. For decommissioning and dismantling two licenses are scheduled in frame of dismantling of WAK. In the conceptual design phase, in every licensing step for construction and operation as well as decommissioning and dismantling TUEV SUED ET has to do the assessments to ensure that all necessary precautions have been taken according to the state of the art and science to prevent damage. Various recommendations on safety requirements were provided by TUEV SUED ET in the expertise to construction (18 requirements in the constructional expertise – construction license 1, 2 requirements in the constructional expertise – construction license 2 and 10 requirements in the constructional expertise – construction license 3 concerning fire protection, radiation protection, labor protection, mechanical engineering, energy power supply, civil engineering and so on) and operation (18 requirements in the operational expertise – operational license 1 and 12 requirements in the operational expertise – operational license 2 concerning process engineering, fire protection, radiation protection, labor protection, mechanical engineering, process control, energy power supply, operational regulation and so on) of VEK from December 1997 to July 2007. The implementation of all these requirements is controlled on-site in the supervision procedure by TUEV SUED ET.

TSO activities during different licensing steps: The superior Subject of safety assessment for VEK plant by TUEV SUED ET is to review if:

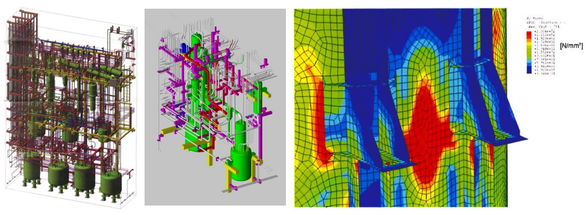
Plant design is in accordance to: -Atomic Energy Act; - Ordinances (e.g. radiation protection ordinance, StlSchV) & - Regulations (e.g. KTA nuclear safety standards);

Confinement system is in accordance to the „state of the art" & Defense-in-depth concept is realized.

Following examples show the complexity and profundity of TSO activities during different licensing steps of VEK:



VEK shielding tests



Structural design review

Shaking tests

3. Summary: For the construction and operation of VEK the regulatory authority commissioned its technical support organization (TSO) TUEV SUED ET in the licensing and supervision procedure to assess the safety design and quality control measures to assure that the precaution measures against the damage are sufficient. The aim is to avoid unallowable enhanced releases of radiological substances to the atmosphere during normal and abnormal operation and under accident conditions caused by internal or external events. Various recommendations on safety requirements were provided by TUEV SUED ET in the expertise to concept, construction and operation of VEK from December 1997 to July 2007. After implementation of all these requirements the complete high-level liquid waste was vitrified. 140 canisters with 56 t of waste glass in total were produced. Five Castor containers were filled with 28 canisters each and transported to the interim storage site North. No unexpected disruptions occured during the operational period of VEK from September 2009 to November 2010.

The decommissioning and dismantling of VEK is now ongoing. The TUEV SUED ET is just as well involved in licensing and supervision procedure for dismantling of VEK and evaluates the planned decommissioning and dismantling steps for safe implementation.