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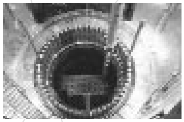
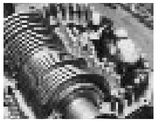
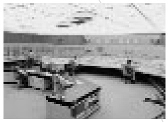
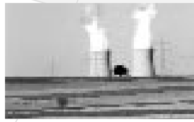

ILK Statement

on the Transportation of Spent Fuel Elements and Vitrified High Level Waste

July 2000
Nr.: ILK-01 E

Executive Summary

In order to avoid future contamination in the transport of spent fuel elements and vitrified highly radioactive waste, an extensive catalog of improvement measures was presented by the operators of German nuclear power plants in cooperation with COGEMA and BNFL and has already been partly implemented. These measures are suited for eliminating any deficits uncovered with regard to

- protection of the shipping cask against contamination through fuel pool water,
- systematic and uniform collection and evaluation of the radiological measurement data and
- documentation of all relevant transport data as well as systematic transmission of necessary information to the participating bodies.

Regarding the potential radiation exposure of the escort staff (police force, railroad personnel) and the population, the following further decisive exposition pathways next to direct radiation through the loaded shipping casks

- inhalation of particles by breathing,
- ingestion of particles by swallowing,
- skin exposure by deposits of particles

were investigated. The evaluation of the outlined exposition pathways based on a Crud-particle with 100 µm aerodynamic equivalent diameter (AED) or 10 µm AED as a reference particle shows that for all three exposition pathways, the highest permissible dose values for small children, adults and the general population prescribed in the EURATOM guideline 96/29 /10/ for individuals in the population were not reached by a large margin.

A hazard to escort staff and the population was not posed by past contamination and is even less likely for future transports.

Therefore, the International Nuclear Technology Commission (Internationale Länderkommission Kerntechnik, ILK) arrives at the conclusion, that the transports

- of spent fuel elements to the central interim storage sites Ahaus and Gorleben,
- of spent fuel elements to the reprocessing plants in France and England as well as
- of vitrified highly radioactive wastes from the reprocessing plants to Germany

can be resumed from a safety-related point of view.

International Nuclear Technology Commission - ILK -

The Chairman

Prof. Dr.-Ing. Josef Eibl
9th of July 2000

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1 Introduction

In late April 1998, the Federal Environmental Ministry (Bundesumweltministerium, BMU) was informed by the French supervisory authority DSIN that contamination of the shipping casks and vehicles had appeared in the transport of spent fuel elements from German nuclear power plants intended for reprocessing at the COGEMA in La Hague /1/. Similar contamination was discovered in casks belonging to French and Swiss nuclear power plants as well as in unloaded casks. The further course of investigations similarly revealed contamination during fuel element transports from German nuclear power plants intended for reprocessing in the UK and in shipping and storage casks in the interim storage site at Ahaus /1/. These contamination findings have led to a discontinuation of the transport of spent fuel elements in France, Switzerland and Germany. The transports have been meanwhile been resumed in France and in Switzerland (cf. Chapter 2.2).

In Germany, the Federal Environmental Ministry stipulated the conditions for resumption of the transports in May 1998 in a so-called 10-point-plan. The measures for implementing these points have meanwhile been presented and evaluated (cf. Chap. 4). Currently, Germany is preparing to resume the transport of spent fuel elements and vitrified highly radioactive waste from reprocessing. The current report represents a statement by the International Nuclear Technology Commission - ILK - on the resumption of these transports.

2 Contamination findings for fuel element transports

2.1 Fuel element transports in Germany

In Germany, an annual average of approx. 400 million t of hazardous goods are transported annually. Of these, about 36,000 t consist of the transport of radioactive materials /2/. On average, there are about 8,500 transports of radioactive waste annually. Until 1998, about 80 of these transports per year involved spent fuel elements that were delivered to the reprocessing plants in France and the UK /2/.

Once the specific activity of 70 kBq/kg has been exceeded, the radioactive substances are labeled as hazardous goods in terms of the transport laws. Such transports require compliance with the regulations according to "Gefahrgutverordnung Straße" (GGVS; Hazardous goods ruling for roads) /3/ and the "Gefahrgutverordnung Eisenbahn" (GGVE; Hazardous goods ruling for railroads) /4/. The regulations stipulating the requirements on the packaging of radioactive materials, dose rates and contamination limit values, labeling etc. are based on international agreements of various intermodal transportation bodies (e.g. roads / ADR, railroads / RID). These international agreements legally implement the effective worldwide recommendations of the International Atomic Energy Agency (IAEA) on the safe transport of radioactive substances (currently Safety Series No. 6 /5/, after 2001 Safety Standards Series No. ST-1 /6/). The regulations of the ADR and RID apply to international transportation in virtually all European states. Furthermore, guidelines of the European Union also exist that prescribe the ADR- and RID-regulations not only for transborder traffic but also for transport within EU-member states. Spent fuel elements as well as high level vitrified reprocessing wastes are transported in type B(U)F-casks according to schedule 12, ADR/RID. The casks must be able to withstand all mechanical and thermal stresses that can arise during normal transport and during potential accidents without impairment to the safety functions of the packaging (secure containment, shielding, heat removal, subcriticality).

An inventory of previous transports /1/ indicated that in a number of fuel element transports from German nuclear power plants to France between 1995 - 1998 the limit value for beta/gamma-surface contamination of 4 Bq/cm^2 had been exceeded by 6% of casks as well as 17% of railroad wagons according to GGVS/GGVE /3, 4/. In transports to the UK, contamination was discovered for 1% of the shipping casks but none for the railroad wagons. In the transport of empty shipping casks from France to Germany between 1988 to 1998, contamination occurred in 5% of the casks and 1% of the railroad wagons. In empty transports from the UK during the same time period, contamination exceeding the above-mentioned limit values were found in 3% of the shipping casks. The majority of contamination values

Statement

established for empty transports figured below 40 Bq/cm^2, full loads frequently reached a value above 400 Bq/cm^2 (max. ca. 4,440 Bq/cm^2). For three empty transports, contamination took the form of particle-shaped activity deposits of up to approx. 100 kBq /1/.

Additionally, the shipping and storage casks of the type CASTOR already stored in the interim storage sites for spent fuel elements at Ahaus and Gorleben were checked for contamination /7/. The inventory showed that with the exception of three casks with negligible contamination (< 10 Bq/cm^2), all CASTOR casks complied with the limit values for surface contamination according to GGVS/GGVE /3, 4/.

2.2 International Approach

In France, fuel transports were resumed as early as July 1998 after various improvements had been introduced. These included technical improvements in loading, standardization of the methods of measurement, an increase in the number of measuring points, and cross-checks by an organization independent of the operators. In 1999 (up until August 15, 1999), limits were found to have been exceeded in the following eight cases out of 212 transports conducted: contamination of two empty casks (6 and 12 Bq/cm^2, respectively), of two trailers (20 and 64 Bq/cm^2, respectively), of four railroad cars (7, 9, 80 and 1,036 Bq/cm^2). The contamination of 9 Bq/cm^2 was detected in an easily accessible place on the platform of the car. 15 out of 20 French nuclear power plants involved conducted all their transports without any findings of contamination. In order to inform the public more comprehensively, a decision was taken by the authorities responsible in France to issue official reports of any limits exceeded on transports on the basis of the international evaluation scale for nuclear events, INES.

In Switzerland, according to the responsible supervisory authority Central Department for the Safety of Nuclear Installations (Hauptabteilung für die Sicherheit der Kernanlagen, HSK), the frequency and extent of limit value transgressions in 1988 to 1998 were roughly comparable, in quantitative terms, with those found in German transports /8/. The HSK had arrived at the conclusion in its statement /8/ that a resumption of transports could be accounted for since the frequency and extent of limit value transgressions henceforth could be clearly reduced by additional measures even if absolute prevention was unattainable. The measures introduced were technical improvements such as the use of a new kind of protective film during loading, an extended program of measurement and administrative and organizational steps. In Switzerland, the first fuel transport after the freeze on transports was conducted in September 1999. Meanwhile, ten transports have been carried out in Switzerland without any evidence of contamination.

The fuel transports within the United Kingdom and in Sweden were never interrupted. As all Swedish power plants and the central repository for fuel elements (CLAB) are situated on the coast, roughly 100 transports per year have been conducted using a special vessel since 1983. TN 17 casks built in the French design are used for this purpose. Additionally, there were some isolated cases in which limits were exceeded when casks arrived at the interim store (partly up to several 1000 Bq/cm^2). These cases must be reported.

In the United States of America, transports of spent fuel from power reactors are insignificant as the fuel elements have so far been kept in on-site interim storage.

3 Potential radiation exposure

Two different kinds of contamination were determined for the shipping casks and railroad wagons. On the one hand, surface contamination was found whose activity rarely exceeded 2,000 Bq/cm^2 /9/. This surface contamination is caused by the transformation of adherent contamination into non-adherent (wipe-off) contamination as a result of environmental conditions during transportation such as temperature fluctuations, rain or dust deposits. The physical-chemical processes and main parameters responsible for this phenomenon, known as "weeping" in the literature, are not fully known /1/. On the other hand, on the cask surface and within the protective guard so-called Crud-particles were found that derived from residues on the fuel elements. From a radiological perspective, these Crud particles are of special significance since they can, among other things, detach themselves from the surface of a shipping cask or railroad wagon and can have a relatively high activity of up to around 100 kBq /9/.

Next to direct radiation (see p. 12), potential radiation exposure of escort staff and population can thus occur in particular via the Crud-particles of the loaded shipping cask /8, 9/. Three relevant scenarios for determining a possible exposure with reference to the aerodynamic characteristics of Crud-particles were identified /9/:

- inhalation of particles by breathing,
- ingestion of particles by swallowing,
- skin exposure through particle deposits.

Statement

The aerodynamic equivalent diameter (AED) of Crud-particles describes the characteristic of particles during airbound transport and during inhalation. The AED is the calculated diameter of a particle that shows the same sedimentation rate as a comparable spherical particle for an assumed density of 1 g/cm^3.

As shown in /8, 9/, depending on the size and thus sedimentation rate, particles are either deposited within the transport vehicle (e.g. in the drip tray of the railroad wagon) or are transported outside by the air current. An evaluation of the contamination established for the shipping casks and railroad wagons showed that the majority of spot contamination were caused by Crud-particles with smaller than 100 µm AED. Larger Crud-particles with correspondingly higher activity up to 100 kBq were only found in isolation in the cooling fins of the TN-shipping casks or the drip tray of the railroad wagon. Particles reaching the size of 100 µm AED are deposited on surfaces like clothes or the ground as a result of being transported in an air current because such large particles, due to inertia, only partly follow the air current /9/. The selection of a Crud-particle with 100 µm AED as a reference-particle represents a conservative approach in terms of the potential radiation exposure. Smaller particles are less active and thus lead to lower doses. Larger particles are so heavy and so un-airworthy that once they detach from the shipping casks they fall downwards, especially into the drip tray of the wagon, and stay there.

Aerosol particles of 100 µm AED have an airborne transport capability of approx. 100 meters. Thus particles having a diameter of 100 µm AED can be regarded as particles with the maximum activity that need to be considered for ingestion and skin exposure scenarios in the immediate vicinity of the shipping casks /9/. The size of the particle relevant to the inhalation path is limited to a maximum diameter of 10 µm AED due to restricted lung permeability.

Next to aerodynamic characteristics, the nuclide-specific composition of Crud-particles also determines the potential radiation exposure. By evaluating numerous radiochemical investigations on nuclide-specific composition, /9/ derived nuclide vectors for Crud from boiling water and pressurized water reactors and used these for calculating the potential radiation exposure. On the basis of these nuclide vectors, a Crud-particle with 100 µm AED has a total activity of approx. 1,800 Bq /9/.

For assessing the effective dose through inhalation and ingestion, the EURATOM guideline 96/29 /10/ was consulted in accordance with /9/. The former conforms to the state of science and technology as laid out in ICRP 60 /11/. The skin dose was calculated according to /9/ with dose factors stated in the corresponding radiation protection commission (Strahlenschutzkommission, SSK) recommendation /12/.

Based on the data in /9,10,11/, the effective subsequent dose for small children (1 year (a)) and adults is given in Table 1 (duration of exposition for small children 70 a, i.e. adults 50 a) after inhalation of 10 µm AED particles (see above, larger particles cannot enter the lungs) or ingestion of 100 µm AED particles. The partial body dose of the skin after exposure to an 100 µm AED particle is also given. Among these exposure scenarios, the major proportion of exposure is caused by higher energetic beta/gamma emitters (e.g. Co-60). Table 1 furthermore presents the limit values for radiation exposure of the general population according to EURATOM-guideline 96/29 /10/. As the data in Table 1 show, the maximum permissible dose rates for the general population are not reached in any of the exposure paths considered.

		Potential radiation exposure		**Limit value**
Path	Reference group	BWR-nuclide ratio(Sv)	PWR-nuclide ratio (Sv)	EURATOM-guide-line 96/29 (Sv)
Inhalation [a] 10 µm AED	small child (1a)	[c] 2,4 E -8	[c] 1,2 E -8	1,0 E -3
	adult	[c] 1,2 E -8	[c] 5,4 E -9	1,0 E -3
Ingestion [a] 100 µm AED	small child (1a)	[c] 1,5 E -5	[c] 5,5 E -6	1,0 E -3
	adult	[c] 2,0 E -6	[c] 1,1 E -6	1,0 E -3
Skin exposure [b] 100 µm AED	population	[d] 8,3 E -3	[d] 5,4 E -3	5,0 E -2

[a] effective dose [b] equivalent dose for the skin [c] calculation basis /11/ [d] calculation basis /12/

Table 1: Effective Dose and Skin Exposure per Crud-Particle in comparison to the corresponding EURATOM-guideline 96/29 /10/ maximum permissible dose values for the population /9/

Other studies /13,14,15/ calculate the potential radiation exposure for the indicated exposition paths on the basis of the largest Crud-particle found with a total activity of approx. 100 kBq (approx. 180 µm AED). Due to the larger activity inventory of the Crud-particle considered, these studies correspondingly arrive at higher values for the potential radiation exposure /13,14/. When taking into consideration the probability for this scenario, the risk of radiation exposure by the observed contamination of the population and escort staff in terms of the exposition paths inhalation, ingestion and skin exposure can similarly be classified as negligible /14,15/. The expert opinion provided by the Öko-Institute /13/, in contrast, does not include the probability for the chosen scenario and only calculates the potential radiation exposure of one person from a specific population group.

In order to arrive at an estimated magnitude of the probability of the exposure of people through Crud-particles of shipping casks, according to /9/, the number of emission incidents and the number of potentially affected persons must be calculated. An evaluation of the contamination findings with regard to number and size distribution of Crud-particles /1/ shows that in the past, around 20 contaminated transports per year occurred. Furthermore, conservative estimates assume that around 10 Crud-particles are released per contaminated transport /9/.The transports were largely carried out from the sites of the nuclear power plants in Germany to La Hague and Sellafield, a few also had Ahaus and Gorleben as their destination. The average transport distance for these transports is about 1,000 km. Following the escape of a particle measuring 100 µm AED in size, this is transported at an average wind speed of approx. 3 m/s for less than 100 m. The conveyance of up to 100 meters on a stretch of 1,000 km can potentially affect an area of approx. 100 km² /transport. Assuming a mean population density in Europe of about 200 residents per square kilometer, around 20,000 people occupy an area of this size. When assuming further that these persons spend around 20% of their time out in the open, about 4,000 people can be affected by a single transport.

When calculating the skin exposure through released Crud-particles, a skin area per person of 0,5 m² is assumed. For an annual number of 20 transports with 10 released Crud-particles each, the probability (P_{public}) that any person within the vicinity of the railroad track is exposed to a particle with size of 100 µm AED and a total activity of approx. 1,800 Bq as a result of a contaminated transport lies at 4 E -3 per year (cf. eq. 1)

$$P_{public.} = \frac{20.000 \text{ persons} \cdot 0{,}2 \cdot 0{,}5\text{m}^2 \cdot 10 \text{ Crud - particles} \cdot 20 \text{ transports/year}}{100 \text{ km}^2 \text{ area}} = 4 \text{ E-3/year.}$$

eq. 1

For a single individual in the specified population group numbering 20,000 persons, the probability (P_P) for skin exposure lies at approx. 2 E -7 per year (cf. eq. 2) /9/

$$P_P = \frac{4\text{E - 3}}{20.000 \text{ persons}} = 2 \text{ E-7/year and person.}$$

eq. 2

In the IBEU study /14/, similar assumptions are made for estimating the probability of person exposures, e.g. in terms of affected surface areas, population density, number of contamination findings, etc. A deviating approach was chosen merely for the number of released Crud-particles, depending on their size /14/. This study estimates that the probability of an individual's skin exposure to radiation varies as a function of size between 2,8 E-8 per year (1,000 Bq-particles) to 2,8 E-11 per year (100 kBq-particles) /14/. Giving consideration to the existing imprecision, the IBEU-study /14/ confirms that the calculation performed above for the potential radiation exposure on the basis of a Crud-particle with 100 µm AED for all three considered exposure paths leads to sufficiently conservative results.

In order to determine the actual radiation exposure through inhalation or ingestion of Crud-particles, whole-body-measurements of plant staff, railroad staff and police were carried out in France, Switzerland and Germany. The evaluation of these findings show that no additional radiation exposures were evident in the contamination findings in any of the cases /7, 8/.

Next to the three exposure paths already indicated, direct radiation by the loaded shipping cask can lead to a potential radiation exposure of the general population and especially of the escort staff. A dose limit value of 1 mSv per year was determined for escort staff such as police officers in accordance with the EURATOM-guideline 96/29 /10/ and on the basis of recommendations made by the German radiation protection commission (Strahlenschutzkommission, SSK) /7/. Thus, the same limit values apply both to the police force and the general population. The evaluation of the corresponding measurements for fuel-element transports /7, 8/ has shown that the limit value of 1mSv for the population according to /10/ both for escort staff and the population is safely complied with /7/.

4 Catalog of measures for avoiding contamination

The contamination findings discovered can be traced back to activated corrosion products or fission products that escaped during handling in the NPP or reprocessing plant either in form of a particle or in a dissolved form (ionic form) that cling to surfaces of the shipping cask that are hard to reach /1/. In order to avoid contamination, the operators of German nuclear power plants have cooperated with the reprocessing plants in France and the UK to suggest and partly already implement a comprehensive catalog of technical, organizational and administrative improvement measures /16/. This catalog consists of:

- technical measures for improving contamination protection during loading in the NPP and unloading in the reprocessing plant,
- an improvement and systematization of the radiation protection measurements,
- a detailed information and reporting system for transportation of spent fuel elements as well as vitrified high level waste as well as
- organizational improvements for the institutes participating in the transports.

The technical improvement measures mainly affect the transports with TN-casks of the COGEMA reprocessing plant in La Hague /16, 18/. These casks have a zone with cooling fins which cannot be sufficiently safely decontaminated to the required level in case a contamination occurs. For avoiding contamination especially in the cooling fin area, these casks are usually wrapped in a further contamination protection skirt made from plastic fibers or additional protective flaps for the upper and lower cask area during loading /16,18/. Additionally, before being reused, the unloaded casks at COGEMA are cleaned from the outside and inside. For transports intended for reprocessing at BNFL, containers of the type NTL 11, CASTOR S1 and Excellox are used. Positive operational experiences have been made with the transport /1/ of spent fuel elements to the interim storage sites Ahaus and Gorleben and to BNFL using CASTOR shipping casks, such as using a Multi-Element Bottle for the Excellox 6 cask. Future transports, however, envisage also using a contamination protection skirt made from plastic fibers as a further measure during loading of these shipping casks.

The systematization of radiation protection measurements covers control measurements of casks and vehicles, the measuring method applied as well as the documentation and evaluation of measurement values. For this purpose, agreements were reached between NPP operators and the COGEMA and BNFL for adopting a common approach in terms of incoming and outgoing measurements at the nuclear power plants, at the reprocessing plants and at reloading stations when changing type of transport /16,18/. The contamination of empty shipping casks is examined in particular by integrated direct measurement methods that also cover the entire cask surface. This systematization of radiation protection measurements is used in transports to the reprocessing plants in France and England, the return of vitrified high level waste from reprocessing as well as for transports to the interim storage sites /18, 19, 20/.

For improving information flow, the operators installed the "Transport, Control- and Information System TKI" for transport of spent nuclear fuels and unloaded casks /17/. This information and reporting system captures the information requirements and -paths between all those involved in the transport on a national and international basis as well as the reporting requirements and reporting paths towards the national supervisory authorities. The computer-aided documentation system captures all relevant transport data for all German nuclear power plants in a uniform way. The data are stored in a central database to which all nuclear power plants and the relevant supervisory authorities have access. Additionally, the reporting system has inbuilt deadlines and limit values that determine further proceedings according to the extent to which limit values have been surpassed.

The technical and organizational measures for improving contamination protection during transportation of spent nuclear fuels to the reprocessing plants have meanwhile been subject to a comprehensive assessment by the GRS and the Öko-Institute and were judged to be suitable in view of the numerous expert opinion conditions /18/. Meanwhile, the positive opinion of the GRS and the Öko-Institute on the implementation of these expert opinion conditions are available /21/. An extensive catalog of measures for the transport of spent nuclear fuels to the interim storage sites Ahaus and Gorleben has also been prepared that was judged to be sufficient by the GRS and the Öko-Institute /19,22/. The same judgment was passed by these two institutions in the assessment of measures in connection with the return of vitrified high level waste from the reprocessing plants to Germany /20,23/.

5 Conclusion

The contamination that was found on shipping casks and railroad wagons in connection with the transport of spent nuclear fuels can be traced back to some extent to the mobilization of clinging contamination but are largely due to deposits of Crud-particles in crevices and gaps that are hard to reach. These contamination are caused by radionuclides dissolved in the water (ionic form) of the fuel pool as well as by suspended particles.

According to current transport law, the contamination findings represent a transgression of the limit value for surface contamination of type B(U)F-shipping casks. The regulations contained therein are based on international agreements of the various transportation bodies and have been legally implemented by nearly all European states in the transport of spent nuclear fuels and vitrified high level waste. The contamination limit values of transport law are, however, deduced values that were introduced preventatively in order to exclude a hazard to persons assigned to handling these shipping materials. A transgression of these values of itself does not mean that a concrete radiological hazard to persons has occurred. Furthermore, according to transport law, these limit values should be regarded above all as reference values for taking decontamination measures on the shipping casks /8/.

In order to avoid future contamination in the transport of spent fuel elements and vitrified highly radioactive wastes, an extensive catalog of improvement measures was presented by the operators in cooperation with COGEMA and BNFL and has already been partly implemented. These measures are suitable to counteract deficits detected in terms of

- protection of the shipping cask from contamination through fuel pool water,
- systematic and homogeneous registration and evaluation of radiological measurement values,
- documentation of all relevant transport data as well as systematic transmission of necessary information to participating bodies.

This catalog of measures has thus created all preconditions necessary for avoiding the contamination of shipping casks for spent nuclear fuels and vitrified highly radioactive wastes. The implementation of similar measures in France and Switzerland has led to the resumption of transport for spent nuclear fuels there /8/. The experiences in France show that the measures taken effectively reduce contamination findings /8/. Switzerland, meanwhile, has carried out ten transports without any evidence of contamination.

Next to direct radiation, the following decisive exposure paths were investigated for a potential radiation exposure of escort staff (police force, railroad staff.) and population by loaded shipping casks:

- inhalation of particles through breathing,
- ingestion of particles through swallowing,
- skin exposure by deposition of a particle.

The surface contamination produced by the so-called weeping phenomenon is negligible in terms of potential radiation exposure compared to contamination by Crud-particles. The evaluation of these exposure pathways on the basis of a Crud-particle with 100 µm AED or 10 µm AED as a reference particle shows that for all three exposure pathways, the maximum permissible dose values for small children, adults and the general population as prescribed by the EURATOM-guideline 96/29 /10/ were clearly undercut. Furthermore, estimates of the probability for radiation exposure through Crud particles shows that the associated risk is negligible. No hazard was posed to escort staff and the population by the contamination findings in the past and is even less likely for future transports. Other studies on this topic that partly rest on different assumptions arrive at similar conclusions in terms of potential radiation exposure and probability /14,15/. The calculations on radiation exposure conducted by the Öko-Institute /13/ rest on extremely conservative assumptions and do not consider the probability of an exposition. Thus, they lead to an overestimate of the potential radiation exposition of the population.

The measurement of direct radiation during the transport of loaded shipping casks or whole body measurements of the escort staff proved /7,8/ that the limit value of 1 mSv per year according to the EURATOM-guideline 96/29 /10/ both for the population and for the escort staff such as railroad staff and police force was safely adhered to.

Statement

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Schreiben von Dr. Otto Majewski an Frau Bundesministerin Dr. Angela Merkel vom 13.08.1998

/17/ Gesellschaft für Nuklear-Service mbH
Transport- Kontroll- und Informationssystem TKI für bestrahlte Kernbrennstoffe und entleerte Behälter (Kurzbeschreibung)
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/18/ GRS / Öko-Institut
Gutachten zur Beförderung abgebrannter Brennelemente in die Wiederaufarbeitungsanlagen November 1999

/19/ GRS / Öko-Institut
Gutachten zu innerdeutschen Brennelementtransporten in deutsche Zwischenlager, Mai 1999

/20/ GRS / Öko-Institut
Gutachten zur Beförderung von verglasten hochradioaktiven Abfällen, Juni 1999

/21/ GRS / Öko-Institut
Stellungnahme zur Erfüllung der Empfehlungen und Hinweise aus dem „Gutachten zur Beförderung abgebrannter Brennelemente in die Wiederaufarbeitungsanlagen“ April 2000

/22/ GRS / Öko-Institut
Stellungnahme zur Erfüllung der Empfehlungen und Hinweise aus dem „Gutachten zu innerdeutschen Brennelementtransporten in deutsche Zwischenlager“September 1999

/23/ GRS / Öko-Institut
Stellungnahme zur Erfüllung der Empfehlungen und Hinweise aus dem „Gutachten zur Beförderung von verglasten hochradioaktiven Abfällen“, Oktober 1999

1. **Prof. Dr. George Apostolakis, USA**
   Professor of Nuclear Engineering at the Massachusetts Institute of Technology (MIT) in Cambridge, USA
2. **Prof. Dr.-Ing. Dr.-Ing. E. h. Dr. techn. h. c. Josef Eibl, Germany** (Chairman)
   Former Director of the Institute for Massive Construction and Building Material Technology at the University Karlsruhe
3. **Prof. Dr.-Ing. habil. Hans Dieter Fischer, Germany**
   Holder of the Chair for Communication Technology at the Ruhr-University Bochum
4. **Ing. Bo Gustafsson, Sweden**
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5. **Prof. Dr.-Ing. Wolfgang Kröger, Switzerland**
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6. **Dr.-Ing. Erwin Lindauer, Germany**
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   Chief Executive Officer of the GfS Gesellschaft für Simulatorschulung mbH
7. **Dr. Serge Prêtre, Switzerland**
   (Director (ret.) of the Nuclear Supervisory Authority in Switzerland, HSK (Hauptabteilung für die Sicherheit der Kernanlagen)
8. **Ing. Louis Reynes, France**
   Vice President (ret.) of the Université de Technologie de Troyes
9. **Prof. Dr.-Ing. habil. Eberhard Roos, Germany** (Vice Chairman)
   Holder of the Chair for Material Testing, Material Science and Material Properties at the University Stuttgart
   Director of the State Materials Testing Institute, University Stuttgart
10. **Prof. Dr. Frank-Peter Weiß, Germany**
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    Professor of Plant Safety at the Technical University Dresden

(Members are listed in alphabetical order)

Objectives of the International Nuclear Technology Commission established by the States Baden-Württemberg, Hesse and Bavaria [Internationale Länderkommission Kerntechnik] - ILK -

Mission

Independently and objectively advising the states Baden-Württemberg, Hesse and Bavaria at the highest, internationally acknowledged scientific level on questions relating to the safety of nuclear installations, the regulated disposal of radioactive waste and the peaceful utilization of nuclear energy against the background of a sustainable energy supply.

Goals

1. Maintenance and improvement of the high safety standard of the German nuclear power plants and further development of the waste management concept for radioactive waste according to the internationally recognized state-of-the-art in science and technology.

2. Application of an holistic system approach to man-technology-organization.

3. Timely detection of safety defects against the background of competition in the liberalized European electricity market and development of countermeasures.

4. Inclusion of internationally acknowledged practice into the German safety philosophy and safety concept for improving state supervision and for increasing the safety standard of installations.

5. Treatment and evaluation of selected safety issues with regard to new scientific insights and development of recommendations on the harmonization of nuclear engineering standards on a European level.