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Innovative Light Water Reactors

Financial Provisions for Nuclear Power Plants

Aspects of Article 37 of the Euratom Treaty

Fuel Cycle Options for Actinides

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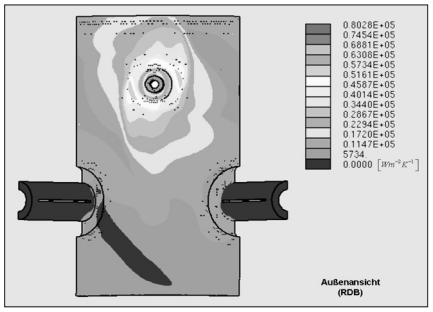
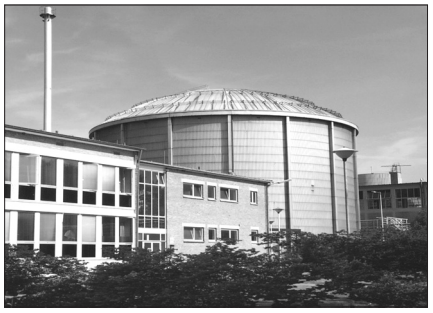


Heat transfer coefficient of the feedwater water at the inner surface of the reactor pressure vessel *(Seite 385)*



Research reactor FRJ-2 (23 MW) at Forschungszentrum Jülich *(Seite 395)*

Titelbild: Trillo nuclear power plant, Spain (Guadalajara). Capacity: 1,066 MW gross and 1,003 MW net. Main contractor: KWU. Owners: Iberdrola (48%), Unión Fenosa (34,5%), Hidrocantábrico (15,5%) y Nuclenor (2%). (Courtesy: Centrales Nucleares Almaraz-Trillo)

International Journal for Nuclear Power
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Beilagenhinweis: Diesem Heft liegen Beilagen des Informationskreises KernEnergie bei.

	Once-Through (OT)	einfach MOX (MOX1)	zweifach MOX (MOX2)	Realitäts nahes MOX (rMOX)
ges. festgel. Laufzeit (gFL)				
Plutonium Masse [t]	~160	~117	~103	~135
Vergleich mit OT	100 %	-27 %	-35 %	-15 %
Americium Masse [t]	~14,5	~12	~11,5	~13,5
Vergleich mit OT	100 %	-17 %	-21 %	-7 %
Curium Masse [t]	~1,1	~2,4	~2,9	~1,7
Vergleich mit OT	100 %	+118 %	+163 %	+45 %
Laufzeitverlängerung				
Plutonium Masse [t]	~37	~23	~15	~37
Vergleich mit gFL	+23 %	+20 %	+14 %	+27 %
Americium Masse [t]	~7	~7,5	~6,5	~6,5
Vergleich mit gFL	+48 %	+63 %	+57 %	48 %
Curium Masse [t]	~0,6	~1,2	~1,5	~0,6
Vergleich mit gFL	+55 %	+50 %	+52 %	+35 %
Gesamt nach 43 Jahren				
Plutonium Masse [t]	~197	~140	~118	~172
Vergleich mit rMOX gFL	+45 %	+3 %	-13 %	+27 %
Americium Masse [t]	~21,5	~19,5	~18	~20
Vergleich mit rMOX gFL	+60 %	+44 %	+33 %	+48 %
Curium Masse [t]	~1,7	~3,6	~4,4	~2,3
Vergleich mit rMOX gFL	±0 %	+112 %	+159 %	+35 %

Überblick über die anfallenden Aktinidenmassen für die verschiedenen Szenarien *(Seite 411)*

ATEL, Schweiz: Rahmenbewilligungsgesuch für neues Kernkraftwerk im Solothurner Niederamt eingereicht. Fotomontage des Standortes mit der generischen Studie des jetzt beantragten neuen Kernkraftwerks *(Seite 415)*

Wie viele Atome stecken in diesen Kugeln, die als nahezu perfekte Kristalle aus nichts als Silicium bestehen? Die Antwort auf diese Frage will die PTB mit ihrem Avogadro-Projekt geben und so zu einer neuen Definition des Kilogramms beitragen. *(Seite 430)*

H. Anglart, E. Laurien and Th. Schulenberg

Nuclear reactor design is still one of the most fascinating subjects of mechanical engineering. Thirty students from 10 worldwide nations demonstrated this impressively in a recent workshop on supercritical water cooled reactors of the 4th generation, held from March 31 to April 3, 2008, in Karlsruhe, Germany, hosted by the Karlsruhe *Institute of Technology.* Bachelor and master students as well as young scientists working on their doctorate presented their own particular contribution to design and analyses of innovative reactor components, including its safety systems and other plant design. Their presentations were accompanied by lectures of leading scientists working in the European project of the "High Performance Light Water Reactor" which is sponsored by the European Commission as part of its 6th Framework Programme. The workshop is an initiative of the *Generation IV International Forum.*

W. Cloosters

To cover the expenses associated with decommissioning and disposal of their nuclear power plants, German nuclear power plant operators set aside a total of more than EUR 30 billion and entered the respective provisions into their balance sheets. One point of eminent importance in this regard is the question whether these provisions are adequate in amount and permitted under accounting and tax laws. The other point to be considered is whether the funds will be available reliably if and when needed.

Against the backdrop of these issues, the practice and importance of making these provisions are described. This is followed by an outline of the basic accounting and taxation aspects. It is seen that obligations under public law can be the basis of financial provisions only if there is an obligation sufficiently concrete in terms of time and object.

The following examination of applicable obligations under the Atomic Energy Act incumbent upon nuclear power plant operators with regard to decommissioning and disposal results in the finding that such obligations are only partly regulated in the Atomic Energy Act, and that specifications in terms of time and purpose are insufficient.

If the national practice of making financial provisions is to be put on a reliable basis, it is recommended to express the law on decommissioning and its mode of financing in more concrete terms in the Atomic Energy Act.

In addition to unequivocal decommissioning and disposal obligations, the Atomic Energy Act should also incorporate regulations about financial provisions for decommissioning which are in need of more precise language.

The present practice of making provisions is characterized by the risk that the funds necessary for planned decommissioning and disposal may not be available when needed. It is against this background that possible solutions reducing that risk are discussed. A recommendation is expressed to establish a public fund for decommissioning and disposal to which the provisions made by nuclear power plant operators to cover the costs of decommissioning and disposal should be transferred.

Chr. Müller-Dehn

The German system of making provisions for nuclear power has been the subject of frequent examinations, and has been approved in each case – by the German federal government, the European Commission, the Court of First Instance of the European Communities and, recently, also by the European Court of Justice.

The article describes the basic legal principles entailing the obligation to make financial provisions for decommissioning and disposal by setting aside the required funds in line with current practice. The management of the assets balancing the provisions, the system of controls, the economic strength of the firms involved and, especially, the demand for the product they sell, i.e. electricity, ensure permanent availability of these funds. Numerous subsidiary legal provisions ensure transparency of these financial provisions.

The external fund model analyzed as an alternative is then rejected both on account of drawbacks in its contents and for legal reasons. Attention is paid to the recommendation by the European Commission of October 2006 about financial provisions for decommissioning and disposal, to which the German system conforms and which does not require the establishment of external funds either. As the system of financial provisions has been operated successfully and reliably in Germany since the beginnings of the use of nuclear power, a plea is made in favor of upholding its structures and functions.

B. Heuel-Fabianek, E. Kümmerle, M. Möllmann-Coers and R. Lennartz

The dismantling of a reactor, even a research reactor, can only take place after the appropriate licence has been granted pursuant to atomic energy legislation. A precondition for granting such a licence is an opinion by the Commission according to Article 37 of the *Euratom* Treaty. To this end, general data relating to the release of radioactive substances for normal operation and in case of accidents via the air and water must be supplied to the Commission.

It can be demonstrated that all releases were very clearly below the limits set for the protection of the population (0.3 mSv) in the EU Member States during dismantling of the FRJ-2 research reactor, in some cases by several powers of ten. It will be therefore practically impossible to measure any radiological impacts resulting from normal dismantling operations. In order to assess any impacts as a consequence of an accident a dose was calculated for the national border closest to the reactor. Even the limit of 1 mSv (Section

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46 German Radiation Protection Ordinance (StrlSchV), Article 13 of the EU Directive 96/29/*Euratom*), which applies to normal operation, is not exceeded at the national boundary in the case of an accident during dismantling work.

In order to avoid a duplication of procedures in considering possible impacts on neighbouring countries by implementing licensing procedures in parallel to an "Article 37 procedure", attention is drawn to the environmental impact assessment (EIA) pursuant to the legislation on environmental impact assessments as part of the licensing procedure. A transfrontier participation of the authorities and public must in any case be implemented here if a project may have a considerable impact on the environmental assets of another country.

Therefore, an amendment of the Recommendation on the application of Article 37 of the *Euratom* Treaty concerning a simple reporting requirement for small impact projects and projects where a transfrontier participation already is implemented according to Council Directive 85/337/EEC is suggested.

Childhood Leukemia ICNIRP/WHO/BfS Workshop, Berlin, May 5-7, 2008 (Page 401)

E. Pasche

The very title, "Risk Factors to Childhood Leukemia," chosen by the 3 organizers of the workshop, i.e. the *International Commission on Non-Ionizing Radiation Protection (ICNIRP),* the *World Health Organization (WHO),* and the *German Federal Office for Radiation Protection (BfS),* made it clear that this disease in its various forms cannot be attributed to any clearcut singular causes. The purpose of the workshop rather was to name and assess, for recommendations about future research, the findings so far obtained in investigating various potential causes, such as environmental impacts like certain infections, viruses, chemicals, drugs, and ionizing and non-ionizing radiation as well as other factors.

The workshop pursued 3 objectives:

1) Updating knowledge and reducing uncertainties.
2) Identifying future main areas of research so as to fill present gaps in knowledge.
3) Elaborating research standards.

Impact on Actinide Arisings in the German Reactor Park of Various Fuel Cycle Options (Page 404)

B. Merk and C. H. M. Broeders

On the basis of the legally stipulated total volume of electricity to be generated in Germany an estimate is given of the amounts of residues arising from reactor operation in terms of spent uranium fuel, plutonium, and minor actinides. Various idealized scenarios are considered as limiting criteria and compared with a realistic scenario in an attempt to show the impacts of various fuel cycle options on the remaining plant life. The case of plutonium reduction by using mixed oxide (MOX) fuels is analyzed in particular. While consistent direct disposal at the end of plant life leaves approx. 160 t of plutonium (upper bound), this quantity can be reduced by some 40 t merely by recycling once. Recycling twice could reduce the amount of plutonium by nearly 60 t (lower bound). Present boundary conditions already reduce the remaining amount of plutonium by some 17 t, which level could be raised to something close to the possible value of 40 t by resuming reprocessing. An additional scenario considered are the impacts on actinide production of plant life extension for all scenarios as a basis for future discussions of the kind already going on in other countries.

Conference of Slovak, Czech and German Nuclear Societies – NUSIM 2008 (Page 413)

V. Slugeň, Václav Hanus and Konstantin Jacoby

This years NUSIM (NUclear Seminar and Information Meeting) took place in Casts Papiernicka, Slovakia from April 24 to 25, 2008. It was the 16th meeting of the organising societies, *Slovenská Nukleárna Spoločnost' (Slovak NUclear Society, SNUS), České nukleární společnosti* (*Czech Nuclear Society, ČNS*), and *Kerntechnische Gesellschaft e.V. (German Nuclear Society, KTG).*

About 120 participants from the organizing countries, guests from European Commission, Austria, Hungary, France and Italy convened at the mountainous recreational resort of Slovak Parliament. Contributions at the conference were presented in successive sessions.

NUSIM 2009 will take place in the Czech Republic.

Implementation of the Meseberg Energy and Climate Program – Part Two (Page 414)

W. Heller

At its closed cabinet meeting at Meseberg Palace on August 23-24, 2007, the German federal government decided on the key points of an integrated energy and climate program. Its main purpose is to meet European targets in the reduction of CO_2 emissions by 20%, the increase in the share of renewable energy sources in the consumption of end use energy by 20%, and energy efficiency increased by 20% by 2020. Most of the measures agreed upon must be implemented by legislation.

At another meeting, the federal cabinet intends to pave the legislative way for the second part of the Meseberg program comprising these legislative projects:

– Legislation on speeding up the expansion of very-high-voltage grids.
– Ordinance on Deregulation of Metrology.
– Amendment to the Energy Conservation Ordinance.
– Heating Cost Ordinance.
– Energy Security Act.
– Switching motor vehicle tax to a pollutant and CO_2 basis.
– Ordinance on Levels of Road Use Charges.

These projects are outlined and discussed. On the whole, and in points of detail, it is striking to see that the regulatory network in Germany is becoming closer and tighter. □

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Ein Reaktor, auch ein Forschungsreaktor, darf erst stillgelegt werden, wenn die entsprechende Genehmigung nach dem Atomgesetz erteilt worden ist. Voraussetzung für diese Genehmigung ist eine Stellungnahme der Kommission nach Artikel 37 *Euroatom*-Vertrag. Dazu müssen der Kommission allgemeine Angaben über die Freisetzung radioaktiver Stoffe über die Luft und das Wasser im Normalbetrieb und unter Störfallbedingungen vorgelegt werden.

Bei der Stilllegung des Forschungsreaktors FRJ-2 lagen alle Freisetzungen nachweisbar deutlich, mitunter um einige Zehnerpotenzen, unter den für den Schutz der Bevölkerung in den EU-Mitgliedstaaten festgelegten Grenzwerten (0,3 mSv). Damit ist es praktisch unmöglich, irgendwelche radiologischen Auswirkungen des normalen Stilllegungsbetriebs zu messen. Um etwaige Auswirkungen infolge eines Unfalls zu beurteilen, wurde für die dem Reaktor am nächsten gelegene Landesgrenze eine Dosis berechnet. Selbst der Grenzwert von 1 mSv (§ 46 deutsche Strahlenschutzverordnung, Artikel 13 EU-Richtlinie 96/29/*Euratorm*), der für den Normalbetrieb gilt, wird bei einem Unfall während der Stilllegung an der Landesgrenze nicht überschritten.

Um Doppelaufwand bei der Prüfung möglicher Auswirkungen auf Nachbarländer durch Genehmigungsverfahren parallel zu einem „Verfahren nach Artikel 37" zu vermeiden, wird auf die Umweltverträglichkeitsprüfung (UVP) nach der Gesetzgebung über Umweltverträglichkeitsprüfungen als Teil des Genehmigungsverfahrens verwiesen. Auf jeden Fall muss eine grenzüberschreitende Beteiligung von Behörden und Öffentlichkeit stattfinden, wenn ein Vorhaben erhebliche Auswirkungen auf die Umwelt eines anderen Landes haben kann. Deshalb wird angeregt, die Empfehlung über die Anwendung von Artikel 37 *Euratom*-Vertrag dahingehend zu ergänzen, dass eine einfache Meldepflicht bei Vorhaben von geringen Auswirkungen und Vorhaben, bei denen eine grenzüberschreitende Beteiligung schon nach der EU-Ratsrichtlinie 85/337/EEC gegeben ist, vorgesehen wird.

The Relevance of Article 37 of the Euratom Treaty for the Dismantling of Nuclear Reactors

Burkhard Heuel-Fabianek, Eberhard Kümmerle, Michael Möllmann-Coers und Reinhard Lennartz, Jülich/Germany

1. Introduction

The last research reactor *FRJ-2* ("*Dido*", *Figure 1*) at *Forschungszentrum Jülich* was finally shut down on 2 May 2006. Therefore, *Forschungszentrum Jülich* initiated the licensing procedure for decommissioning. The responsible authority is the *Ministry of Economic Affairs and Energy* (*MWME*) of the German state of North Rhine-Westphalia.

The decommissioning of a nuclear reactor has to be licensed pursuant to the German Atomic Energy Act (Atomgesetz, AtG). The requirements for the construction and operation of a reactor apply analogously to the decommissioning of a reactor, even a "small" research reactor of some 23 MW_{th}.

Part of the licensing process is an involvement of other relevant authorities on the federal, state and local level, and also the public.

Fig. 1. Research reactor FRJ-2 (23 MW_{th}) at Forschungszentrum Jülich, Germany.

Anschrift der Verfasser:
Burkhard Heuel-Fabianek,
Eberhard Kümmerle,
Michael Möllmann-Coers und
Reinhard Lennartz
Forschungszentrum Jülich
Dept. of Safety and Radiation Protection
52425 Jülich
Germany

2. The Course of the Licensing Procedure

The licensing procedure is complex and time-consuming. Consequently various documents, reports and expert opinions have to be written and delivered to the competent authority, e.g. safety report, technical documents, results of traffic counting, assessment of population exposure. Additionally an environmental impact study (EIS) has to be submitted as the basis for the environmental impact assessment (EIA) according to Council Directive 85/337/EEC and the respective German legislation (Umweltverträglichkeitsprüfungsgesetz – UVPG). The environmental impact assessment is integrated into the licensing procedures according to the German Atomic Energy Act.

The environmental impact study concerns the actual environmental situation at the site pursuant to Council Directive 85/337/EEC, amended by Directive 97/11/CE of 3 March 1997, with respect to

– human beings, fauna and flora,
– soil, water, air, climate and the landscape,
– material assets and the cultural heritage,
– the interaction between the factors mentioned in the first, second and third indents.

It also describes the significant direct and indirect effects of a project on the environment.

Projects which are likely to have direct and indirect effects and are consequently the subject of an EIA as part of the licensing procedure are listed in annex I of 85/337/EEC. Nuclear power stations and other nuclear reactors are listed in the annexes.

In annex 1, the German UVPG also defines nuclear power stations and other nuclear reactors (> 1 kW continuous thermal load), which have to be subjected to an EIA. In addition, the decommissioning and dismantling of such nuclear reactors shall be made subject to an EIA.

As part of a licensing procedure with an integrated EIA, it has to be verified whether a project is likely to have significant effects on the environment in another Member State. If so, the authority shall forward the information to the other Member State. Details of this involvement are regulated in Art. 7 and 9 of Directive 85/337/EEC and the German UVPG.

Article 37 Euratom Treaty

Euratom, to which the Federal Republic of Germany acceded as a founding member in 1957, and which has been an integral part of the European Communities, and thus of the EU, since 1965, also comes into play here. Article 37 of the *Euratom* Treaty (*Box 1*) obliges every Member State to communicate certain data relating to the release of radioactive substances to the Commission. This information must reveal whether and if so what radiological impacts dismantling of *FRJ-2* – planned disposal and accidental release – will have on the environment, i.e. water, soil or airspace, of the EU Member States. On the basis of these general data, the Commission must be in a position to assess the exposure of reference groups of the population in the nearest neighbouring states [*Janssens,* 2004].

> *Each Member State shall provide the Commission with such general data relating to any plan for the disposal of radioactive waste in whatever forms will make it possible to determine whether the implementation of such plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State. The Commission shall deliver its opinion within 6 months, after consulting the group of experts referred to in Article 31.*

Box 1. Article 37 Euratom Treaty.

The general data are provided by the *German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* (*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU*) supported by the *Federal Office for Radiation Protection* (*Bundesamt für Strahlenschutz, BfS*). The data required are normally compiled by the applicant.

Details of the implementation of Article 37 and the provision of data are given in the Commission Recommendation of 6 December 1999 on the application of Article 37 of the *Euratom* Treaty (1999/829/*Euratom*). The recommendation is also part of the Handbook on Nuclear Safety and Radiation Protection [*Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, BMU*].

The recommendation by the Commission made in 1999 is based on the recommendations from 1990 and takes into consideration experience with decommissioning and the dismantling measures required at that time in particular for power reactors in the new Member States in eastern Europe [Commission of the European Communities].

Licences for dismantling may only be granted by the competent authorities, in this case MWME, if an opinion has been received from the Commission, which is then also published in the Official Journal of the European Union. The Commission then has six months after hearing the group of experts to deliver its opinion. Both the six month deadline and also the entire "Article 37 procedure" proceed independently of the licensing procedure under the German Atomic Energy Act, according to which the six- month period only begins when the data are deemed to be complete.

A comment in the Official Journal briefly describes – usually not more than a page – which project is involved, the distance from the nearest national border to another Member State, possible exposure of the population during normal decommissioning operations and in case of accident, and also what is to be done with the radioactive waste arising [Commission, 2007 a, 2007 b, 2008]. A concluding statement summarizes the Commission's opinion on whether significant radioactive contamination can be caused by normal operation or an accident.

The basis of the opinion is the data provided by the Member State on the plan for disposing of radioactive waste (Article 37 *Euratom* Treaty), and if necessary any additional information that the Commission may request from a Member State if the data provided is not sufficient and also the findings of a hearing of a group of experts (Article 31 *Euratom* Treaty).

The members of the group of experts are appointed by the Scientific and Technical Committee set up in compliance with Article 134 of the *Euratom* Treaty for a term of 5 years. In practical terms, the tasks of the Group of Experts with respect to Article 37 are carried out by a separate group of experts [*EURATOM*, 2007].

The Commission's opinion is not legally binding for the Member State. However, the Member States usually comply with the opinions and any recommendations made, e.g. on emergency plans and emission limits [*Hampe* et al., 1984].

Nevertheless, without a published opinion from the Commission, authorization from a national authority for a facility coming under Article 37 will ultimately force the Commission to take a formal complaint to the European Court of Justice.

3. Dispersal and Dose Calculations

In consultation with *MWME* and the *Federal Office for Radiation Protection* (*BfS*), *Forschungszentrum Jülich* provided "Data Pursuant to Art. 37 of the *Euratom* Treaty for the Decommissioning and Dismantling of the *FRJ-2* Reactor Plant, *Forschungszentrum Jülich GmbH*". In addition to the impacts of normal dismantling operation, the possible effects of an accident were also investigated. The assessments are

based on corresponding dispersal and dose calculations.

There has been a great deal of discussion on the accuracy of dispersion calculations via the air over distances of hundreds or thousands of kilometres. It is clear that at more than 20 to 30 km the accuracy becomes extremely low and the forecast then becomes increasingly speculative.

The question of the effective dose received by the population in distant EU Member States, Cyprus for instance, due to dismantling of *FRJ-2* can then not be meaningfully determined due to the distance (in the case of Cyprus) from *FRJ-2* of about 2,800 km and the extremely low calculated dose. The same is true of most other countries. Only considerations based on calculations in the immediate region (see above) and on the prescribed limits for the protection of the population are of assistance here.

The calculation approach proceeds from 2 transfer pathways for possible radioactive emissions in normal operation and in case of accident: the pathways of air and water.

Calculations for the Air Pathway

Normal Operation

The basic source term for emissions via the air pathway for *FRJ-2* in normal operation is derived from the proposed limits (decommissioning/dismantling) of the maximum permissible radioactive discharges. In the case of the effective doses, the highest dose caused only by the *FRJ-2* reactor is 27.9 µSv/a (1- to 2-year-old infants) at the perimeter fence of *Forschungszentrum Jülich* in comparison to 140 µSv/a as the highest effective dose caused by all emitters on the Jülich campus.

In order to assess the exposure of the population in the more extensive region of up to about 20 km from the *FRJ-2* reactor plant – which can still be meaningfully calculated – a grid of test points was defined and the respective dose for various groups of the population was then determined for each point. The calculations covering a distance of up to about 20 km thus also include the border to the nearest neighbouring country, the Netherlands.

These calculations are based on the General Administrative Regulations (AVV, draft of 13.05.2005) concerning Section 47 of the Radiation Protection Ordinance (Strahlenschutzverordnung, StrlSchV). For the ingestion pathway, it was assumed that food was consumed at the place of origin.

At a distance of 20 km, the maximum annual dose resulting for the population group of infants was about 1.0 µSv (1.0 E-06 Sv, *Figure 2*) and for adults (over 17 years of age, *Figure 3*) roughly 0.5 µSv (5.0E-07 Sv). In comparison, the permissible effective dose for discharges via the air pathway – defined in Section 47 StrlSchV – is several orders of magnitude higher at 300 µSv/a.

Since the calculated dose decreases with increasing distance, it can be demonstrated for all neighbouring states and EU Member States – including most distant Cyprus – that the effective dose for the local population is clearly or extremely clearly below the above-mentioned values, i.e. below 1.0 µSv (infants) and 0.5 µSv (adults).

A comparison with the natural γ dose rate is also interesting. In Germany, this dose rate is between about 80 und 170 nSv/h, which corresponds to an annual dose of 0.7 to 1.5 mSv. In comparison to the natural dose rate, the annual dose rate at the border with the Netherlands described above is smaller by 3 orders of magnitude. Due to the amplitude of the natural γ dose rate, the very low annual dose resulting from emissions caused by dismantling of the FRJ-2 could no longer be measured.

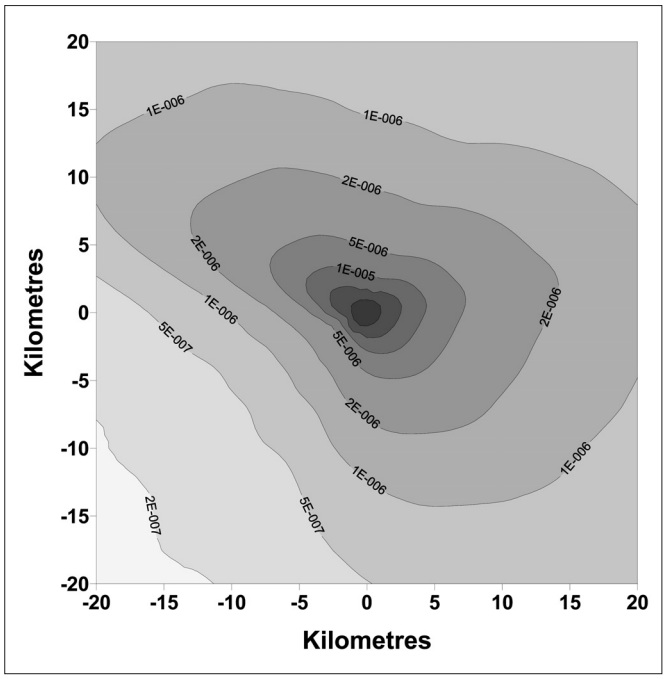

Fig. 2. Effective dose for infants [Sv a^{-1}] around the research reactor FRJ-2 – forecast based on all emission sources.

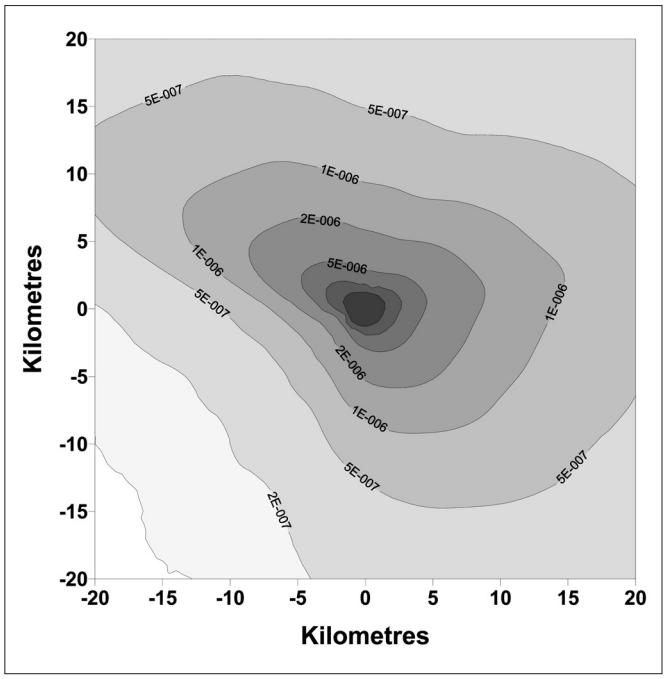

Fig. 3. Effective dose for adults [Sv a^{-1}] around the research reactor FRJ-2 – forecast based on all emission sources.

Accident

A maximum conceivable release of activity is assumed for an accident. To this end, it is assumed that at a certain phase of the dismantling process freely accessible graphite from the reactor reflector is heated up to a temperature of approx. 1,100 °C under unfavourable boundary conditions. It is furthermore assumed in this scenario that the reactor hall of the *FRJ-2* no longer has any retentive function.

The maximum effective dose for persons outside the campus of *Forschungszentrum Jülich* is calculated for a fictitious person who is at the perimeter fence during and after the accident (inhalation, submersion, background radiation at a distance of 290 m) and consumes food grown at a distance of 2,000 m from *FRJ-2* throughout his life.

In order to assess the possible impact on neighbouring countries as a consequence of an accident, the dose is calculated as a conservative estimate analogously to the basis for calculating the accident for the national border that is located nearest to the *FRJ-2* reactor. This is the German-Dutch border at a distance of a little over 20 km. For the group of 0- to 1-year-old infants as the most sensitive group a maximum effective dose of 0.022 mSv is obtained at this distance without ingestion and of 0.9 mSv with ingestion.

The corresponding maximum effective dose for all neighbouring countries and EU Member States that are even more distant than the German-Dutch border is clearly to extremely clearly below the above-mentioned values.

The limit of the effective dose from radiation exposure arising from professional activities (note: not accidents) pursuant to Section 2 Clause 1 No. 1 Radiation Protection Ordinance (StrlSchV) amounts to 1 mSv (= 1,000 µSv) per calendar year according to Clause 46 StrlSchV for the protection of individuals. The same is prescribed in Article 13 of the EU Directive 96/29/*Euratom,* which also specifies a limit of the effective dose for individual members of the population of 1 mSv per year. Even this limit of 1 mSv, which is not valid for accident-related emissions, is not exceeded outside the national borders of the Federal Republic of Germany in the case of an accident during the decommissioning and dismantling of *FRJ-2*.

Calculations for the Water Pathway

After being treated separately, the radioactive effluents from *FRJ-2* are discharged via a mechanical and chemical sewage plant together with the other waste water to a river, representing the most unfavourable point of impact for calculating the annual maximum dose pursuant to Section 47 StrlSchV.

As a source term, the dose calculations for the water pathway use the approved limits for the discharge of radioactive substances with the water and are also performed according to the calculation methods pursuant to the draft of the General Administrative Regulations (AVV) concerning Section 47 StrlSchV (see above).

Using the models, exposure pathways and parameters of the AVV, an annual maximum dose of 15 µSv can be calculated for the most highly exposed reference person (age group: ≤ 1 year). Below the most unfavourable point of impact, this dose is reduced by the corresponding dilution of the effluents by additional inputs of water.

The actual discharges lead to a significantly lower dose since as a rule they remain below the approved emission values.

The Netherlands is the only EU Member State downstream of the discharges. Taking the dilution into consideration (see above) from other tributaries, the effective dose of the most sensitive group of persons (≤ 1 year) and thus also all other groups for the discharges on Dutch territory can be estimated to be less than 10 µSv/a.

The annual maximum dose for the most sensitive population group as well as for all other groups downstream of the entry of the water into the Meuse (Netherlands) is less than 1.0 µSv/a since a further dilution of at least 1:10 takes place at the confluence.

4. Alternative/Amendment to the "Art. 37 Procedure"

In view of the only hypothetically detectable, very low radiation exposure in the neighbouring EU Member States – even in the case of an accident – during dismantling of the research reactor, the extent

to which the "Art. 37 process" can be of assistance is very doubtful. A formal simplification, such as an obligation to provide data pursuant to Art. 37 of the *Euratom* Treaty only in cases involving participation by authorities and the public on a transfrontier basis in the licensing procedure under the German Atomic Energy Act with integrated assessment of environmental impact (Sections 8 and 9a of the Environmental Impact Assessment Act (UVPG)) would be a first step towards reducing time and effort.

With respect to the protection of the environment, in comparison to the "Art. 37 process", the Environmental Impact Assessment Act (UVPG) takes a more comprehensive approach since it does not only consider water, soil or airspace (Art. 37 *Euratom* Treaty) but in addition humans, human health, animals, plants, biodiversity, climate, landscape as well as cultural assets and other physical goods (Section 2 UVPG).

According to the UVPG, this transfrontier participation is only required if a project may have considerable impacts on the environmental assets pursuant to UVPG (Section 2 UVPG) (see above). Section 8 of the UVPG regulates the transfrontier participation of the authorities. However, a state may also insist on consultations with the competent German federal and regional authorities on transfrontier environmental impacts and measures for preventing or reducing such impacts.

UVPG (Section 9a) also provides for transfrontier participation by the public if a project may have a considerable environmental impact on another state. The legal justification refers explicitly to the rulings developed in the atomic energy legislation on the *"Principle of Equality of Treatment of Nationals and Nonnationals"* [*Gassner*, 2006]. This would therefore include all the dismantling procedures without any obligation to provide general data pursuant to Art. 37 of the *Euratom* Treaty, in which due to a lack of considerable environmental impacts transfrontier participation can be dispensed with in the licensing procedure under atomic energy legislation.

Furthermore, Art. 37 of the *Euratom* Treaty only needs to be taken into consideration if a project is expected to result in increased exposure of the population. The extent to which this applies to the dismantling of a (research) reactor is not decided by the Member State where the project is to be implemented but by the Commission [*Janssens* et al., 2005]. Nevertheless, especially in the case of reactors with a low radioactive inventory after removal of the fuel elements, it can generally be assumed that significantly less radioactivity will be emitted than before decommissioning.

From the historical perspective, when the *Euratom* Treaty was concluded in 1957 (see above) it represented pioneering legislation concerning binding transfrontier obligations with respect to environmental impacts and protection of humans. Almost 30 years later, the EU Environmental Impact Assessment Directive (EIA Directive) created an instrument which obliged the Member States to examine whether transfrontier participation by the authorities or public was required in all licensing procedures with EIAs. Historically speaking, there are thus two independent sets of rules – the treaty establishing the *European Atomic Energy Community* (EAEC Treaty) and the EIA Directive – on the participation of other states in licensing procedures, which have the same objective independent of each other. The only point of contact is in the licensing procedure with EIA and the obligation to provide data pursuant to Art. 37 of the *Euratom* Treaty (*Figure 4*).

If the position were rigorously thought through, it would therefore be possible to dispense completely with the "Art. 37 process" for facilities or disposal of radioactive waste which have a small radiological impact on humans and the environment. There would be no loss of information or restriction on participation since transfrontier participation by the authorities and public is already provided for in the licensing procedure pursuant to atomic energy legislation with EIA if considerable impacts are to be expected on environmental assets including humans and human health.

To address the importance and complexity of the *Euratom* Treaty for the

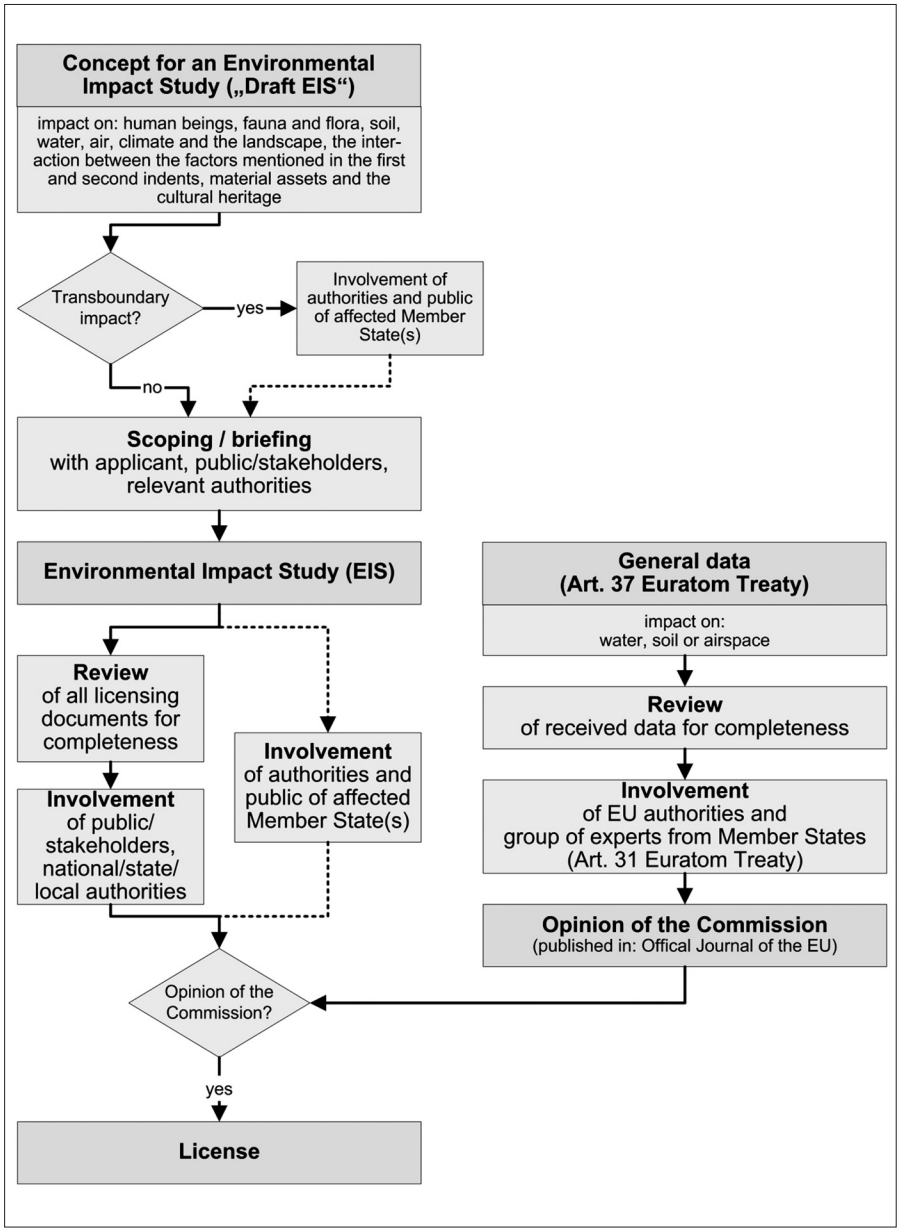

Fig. 4. Environmental impact assessment and Article 37 process – comparison and connection.

communication among the member states and between the member states and the Commission concerning nuclear emissions a future amendment of the Recommendation on the application of Article 37 of the *Euratom* Treaty should comprehend a "simple" reporting requirement for such projects with a small radiological impact.

5. Conclusions

On the basis of the calculations for the pathways of air and water, it was demonstrated for all EU Member States, including directly adjacent states, that releases of radioactivity will remain significantly or very significantly below the limits for protecting the population (0.3 mSv = 300 µSv), i.e. by several powers of ten, during dismantling of the *FRJ-2* research reactor.

The calculations also indicate that radiological impacts arising from the dismantling process would remain significantly (in part by several powers of 10) below the relevant limits, or indeed that they could no longer be measured.

If after hearing the group of experts, the Commission should adopt this assessment and publish a statement in the Official Journal of the EU then this would fulfil a formal requirement for granting approval for the dismantling of *FRJ-2* pursuant to atomic energy legislation.

In parallel, any possible impacts on the environmental assets of the Environmental Impact Assessment Act (UVPG) – see above – and the requirements for the protection of the public against ionizing irradiation must be investigated and evaluated in the licensing procedure for the dismantling of a reactor pursuant to atomic energy legislation.

After this comprehensive assessment in the licensing procedure under the Atomic Energy Act, if all other conditions have been fulfilled for the granting of a licence, approval can be given for the dismantling operation.

This double assessment of environmental impacts arising from dismantling operations pursuant to Art. 37 of the *Euratom* Treaty and also according to the Environmental Impact Assessment Act (UVPG) does not only lead to considerably more expenditure in making an application and implementing the assessment. In the most unfavourable case, this can also result in a delay in granting the licence under atomic energy legislation if the Commission has not yet published a positive comment.

Since the UVPG ultimately implements the EU Directive on the environmental impact study for certain public and private projects (Directive 85/337/EEC) and the *Euratom* Treaty is in any case binding for EU Member States, it would be desirable to simplify the process here on a European level. It might be possible to make use of appropriate initiatives by the Commission to reduce administrative load and to simplify the regulatory environment as part of the EU strategy *"Partnership for Growth and Jobs"*.

However, this simplification is hindered by the fact that as yet the *European Atomic Energy Community* (*Euratom*) has not merged with the European Community. *Euratom* therefore retains its own status as a legal entity even if the 2 have joint bodies [*Pröfrock*, 2007]. It is therefore to be hoped that the revision of the *Euratom* Treaty currently being discussed on a European level, amongst other aspects with respect to the lack of harmonized standards for the decommissioning of nuclear engineering facilities [European Parliament, 2007], can provide a remedy here.

One suggestion is an amendment of the Recommendation on the application of Article 37 of the *Euratom* Treaty concerning a simple reporting requirement for small impact projects and projects where a transfrontier participation already is implemented according to Council Directive 85/337/EEC.

With the Treaty of Lisbon (European Union, 2007) signed in December 2007 an amendment to the *Euratom* Treaty was also resolved in order to improve cooperation. However, in *Euratom* working practice it is hardly to be expected that there will be any perceptible changes in the immediate future [*Thomas,* 2008].

In the environmental field, however, the Directive concerning integrated pollution prevention and control (Directive 96/61/EC) and other related legal regulations are due to be simplified [Commission, 2006]. An extension of the approach to include a simplification and harmonization of the *Euratom* Treaty and Directive 85/337/EEC would now seen appropriate.

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