

Die Regierung der Republik Türkei geht seit einigen Jahren sehr entschlossen voran, um bis zum Jahre 2020 das erste Kernkraftwerk in der Türkei in Betrieb nehmen zu können. Das weit über dem EU-Durchschnitt liegende Wirtschaftswachstum der Türkei erfordert eine moderne und verlässliche Energieversorgung für die Bevölkerung und Wirtschaftsunternehmen. Energiepolitische und energiewirtschaftliche Entscheidungen der Regierung der Republik Türkei für die Verwirklichung der notwendigen Schritte zur Erreichung der Energieversorgungsziele werden zügig umgesetzt. Dabei spielt die Verringerung der Abhängigkeit von Energieimporten eine wesentliche Rolle. Hierzu soll der Aufbau der Kernenergie in der Türkei genutzt werden. Kernkraftwerken werden geringere ökologische Nachteile als fossilen Energieerzeugungsformen und höhere Erzeugungsverlässlichkeit als Wärme- oder Wasserkraftwerken zugestanden. Der Standort für das erste Kernkraftwerk in Mersin-Akkuyu ist festgelegt und wird wissenschaftlich systematisch untersucht, damit der von der Regierung ausgewählte russische Partner die Anlage errichten und betreiben kann. Für das am zweiten Standort in Sinop-İnceburun vorgesehene Kernkraftwerk wird die Ausschreibung vorbereitet. Das energierechtliche und vor allem das atom- und strahlenschutzrechtliche Vorschriftenystem einschließlich des sog. untergesetzlichen kerntechnischen Regelwerks für kommerzielle Kernkraftwerke wird fortentwickelt. Insbesondere die erforderlichen sicherheitstechnischen Vorgaben für Errichtung und Betrieb der Kernkraftwerke müssen weiter ausgearbeitet werden. Das für die Verfahren benötigte Personal bei Behörden und im Expertenbereich ist auszubilden und für die Praxis intensiv vorzubereiten. Vor diesem Hintergrund werden im Anschluss an den Bericht in atw 2007, 15 ff vor allem die sicherheitstechnischen Aspekte der Kernkraftwerke im Hinblick auf ihre Planung, Standortauswahl, Errichtung und Betrieb betrachtet. Ohne verlässlichen Rechtsrahmen und fundiertes Regelwerk können Genehmigungsverfahren für Errichtung und Betrieb kaum bewältigt werden, die währenddessen durchzuführende Aufsicht dürfte nicht effizient und somit die Sicherheit gewährleistet wahrgenommen werden können. Der bisher eingeschlagene Weg in der Türkei wird auch kurz mit wesentlichen Grundlagen in Ländern verglichen, die über eine lange Erfahrung mit der friedlichen Nutzung der Kernenergie verfügen. Zusammenfassend kann nicht verlässlich prognostiziert werden, ob in der Türkei die ambitionierten Planungen zur Kernenergienutzung zeitgemäß vom Betreiber und der zuständigen Atombehörde umgesetzt werden.

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Turkey's way to nuclear energy – An example for a newcomer's new build

**Bin ölçüp bir biçmeli.
(Turkish proverb meaning that it is worth weighing up thousand times in order to reap once.)**

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During the years 2001 to 2010 economic growth averaged 1.3 % in the EU-27 and reached 1.1 % in the Euro-Zone, whereas Turkey recorded an average economic growth of 4 % [1] in the same period, which was associated with an increase in the demand for electricity [2]. In the 1980s and 1990s, the energy-mix was depending mainly on thermal generation, but has undergone with the increase in hydro generation by the Southeastern Anatolia Project a steady development and significant increase in capacity [3]. Nevertheless, Turkey's energy sector remained dependent on imports, since over 70 % of domestic energy consumption had to be imported in 2010 [4]. Turkey had intended the use of nuclear energy for quite some time, but has undertaken consistent steps only since 2004 [5]. Finally, after the determined and ambitious actions by the government, the likelihood further substantiated in 2012 that Turkey will have its first nuclear power plant in the near future [6]. Status and prospects in the areas of energy economics and energy legislation as well as in nuclear and radiation protection regulation including safety requirements for commercial nuclear power plants justify this assessment. However, there is still a consolidation of the nuclear legislative and regulation system needed.

1. The roadmap of Turkish energy policy for nuclear energy

The Ministry of Energy and Natural Resources (ETKB) outlines with regard to its mission «to ensure efficient, effective safe and environment-sensitive use of energy and natural resources in a way that reduces external dependency of our country, and makes the greatest contribution to our

country's welfare» the following general facts and expectations: «Secure energy supply remains essential also for our country. In this context, significant progress has been made recently in legal and technical terms which include restructuring our energy market on a competitive transparent basis, identifying and utilizing our domestic and renewable resource potentials, making nuclear energy a part of electricity production, and making use of energy efficiency and new energy technologies. Turkey's energy policy principally aims at: Making energy available for the consumers in terms of cost, time and amount, exploiting public and private facilities within the framework of free market practices, discouraging import dependency, securing a strong position for our country in regional and global trade of energy, ensuring the availability of diversified resources, routes and technologies, ensuring maximum use of renewable resources, increasing energy efficiency, minimizing negative environmental impact while producing and using energy and natural resources. Between 1990 and 2008 in our country, [the] annual average rate of increase in primary energy demand was realized as 4.3 %. Among other OECD countries, Turkey has had the highest rate of energy demand increase of the past 10 years. Similarly, since 2000, our country has been the second largest economy after China for having the highest rate of increase in electricity and [natural] gas demand. Projections by our Ministry show that this trend will continue in the medium run. In 2008, total primary energy consumption of our country was realized as 106.3 million TEP, while production was at 29.2 million TEP. Of total energy supply, [natural] gas comes first (32 %) which is followed up by petrol [oil] (29.9 %), coal

(29.5 %), and renewable energy sources including hydraulic [sources] (8.6 %). Based on the reference scenario, our primary energy consumption is expected to increase by 4 % annually by 2020.» [7] The latter is in harmony with the estimated rates of economic growth in Turkey of about 3 to 4 % by 2016 [8].

With regard to electricity and nuclear energy, *ETKB* declares [9]: «Our electricity generation is expected by 2020 to reach 499 TWh with an annual increase of around 8 % according to the higher demand scenario, or 406 TWh with an annual increase of 6.1 % according to the lower demand scenario. As of 21 July 2010, our installed power has now reached 46,126 MW after the deployment of a new power plant of 1,479 MW. In 2009, our electricity generation came from 3 main sources: natural gas by 48.6 %, coal by 28.3 %, hydroelectric by 18.5 %, liquid fuels by 3.4 %, and renewable resources by 1.1 %. ... A 1,000 MWe nuclear reactor produces about 27 tons (7 m³) of used fuel in a year. Environmental impact of fossil fuel powered (especially coal powered) power plants is too negative to be even compared to nuclear power plants. On the contrary, nuclear power plants must be preferred for their environmental qualities. Maximum radiation from nuclear reactors under normal operational conditions is limited to 0.1 to 1 of the natural radiation level, and the situation in practice is even below these limits. For the continuity of electricity generation, nuclear power plants are safer and have higher availability compared to thermal and hydraulic power plants. Next to global developments that make renewable energy sources more common spread, nuclear energy investment projects are also gaining impetus worldwide. Based on [electricity] energy supply and demand projections, it is targeted by 2020 that nuclear power plants will have a minimum of 5 % share in electricity production.» Most recently, the Energy Minister *Taner YILDIZ* has credibly underlined the determination of the Turkish government to implement nuclear energy [10].

2. The legal framework for energy and the law no. 5710 of 2007 as a starting point for rapidly developing activities on nuclear energy

The *ETKB*'s competence is based on the law concerning its organization and functions [11]. For energy supply, the task assigned is to investigate the country's short- and long-term energy needs, to support an appropriate energy supply policy and to take the necessary measures, especially in the areas of research, implementation, development, evaluation, control and protec-

tion, and to found and establish the appropriate institutions (Article 2 lit. a-c, f, g). The energy market is regulated particularly by the Electricity Market Law No. 4628 of 2001 together with the Law on the Amendment of Electricity Market Law No. 5784 on Supply Security and Certain Other Laws (2008), the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (2005, amended in 2010), the Energy Efficiency Law (2007) and the Law on Geothermal Resources and Mineral Waters (2007) [12]. The main institutions attached and related to the *ETKB* are the *Turkish Electricity Transmission Company (TEİAŞ)*, the *Electricity Generation Corporation (EÜAŞ)*, *Turkish Electricity Trading and Contracting Company Inc. (TETAŞ)*, the *Energy Market Regulatory Authority (EPDK)* and the *Turkish Atomic Energy Authority (TAEK)* [13]. The energy market in Turkey has already been largely privatized and is being tightly regulated in order to achieve the targets identified by the government. Renewable energy sources, particularly wind and solar energy, are heavily subsidized [14].

For nuclear energy the regulatory body was installed in 1982 by the Law on *Turkish Atomic Energy Authority (TAEK)* [15]. The regulatory body is obliged above all «to determine the basis of the national policy and the related plans and programmes in connection with the peaceful utilization of atomic energy for the benefits of the State and ... to do all kinds of research, development, studies and activities and have them done [in order to be able to use atomic energy for the sake of the] State's scientific, technical and economic development and to coordinate and support such activities done in this field» and «to give approval, permission and license related to the site selection, instruction [construction], operation and environmental protection of nuclear power and research reactors and nuclear fuel cycle facilities; to do necessary studies and controls, to limit (restrict) the operating authority in case of noncompliance with the permission or license; to cancel permanently or temporarily the permission or license given and to make recommendations to the Prime Minister for the shutdown of those installations; to prepare the necessary technical guides, decrees and regulations for those purposes» (Article 4 lit. a, e) [16]. Already in 1983 the Decree on Licensing of Nuclear Installations was enacted [17]. Besides this executive order which is still valid today, there is no Nuclear Energy Act which embodies comprehensive rules, such as in Germany, France, Sweden and Switzerland [18]. A draft law, announced in 2009, has not been disclosed to the public until today, and intentions to pick up such a legislative initiative are not known actually [19]. The accomplishment of obligations undertaken

by Turkey with ratifying the Convention on Nuclear Safety [20] and in view of the EU accession process to transpose the COUNCIL DIRECTIVE 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations [21] for the *acquis communautaire* can not be verified.

Fundamental and direction-setting for the consistently chosen path to nuclear energy in Turkey since 2004 is Law No. 5710 on Construction and Operation of Nuclear Power Plants and Energy Sale of 9 November 2007 [22]. It regulates besides nuclear technology particular aspects of energy economics: «This Law also introduced regulations regarding the utilization of domestic coal resources for the purpose of generating electrical energy, encouraging the establishment [of] domestic coal fired thermal power plants.» [23] Goal and scope of the law are described in Article 1: «The aim of this law is to provide, in accordance with the energy plan and policy, the procedures and principles for the construction and operation of nuclear power plants and the sale of energy from those plants.» «*TETAŞ* shall call for bids» on the basis of «constructing and operation criteria» and a regulation on «the procedures and principles» to be set up and published by *TAEK* respectively by *ETKB* and the Council of Ministers (Article 3 paragraphs 1 – 4). *TETAŞ* has to assess the bids and to submit to the Council of Ministers the bid determined to be the most appropriate; after authorization by the Council of Ministers, *TETAŞ* and the enterprise shall sign the contract foreseen in the law and *EPDK* shall grant a license to the enterprise. Finally *TETAŞ* and the enterprise shall sign an agreement «arranging for energy sales within a timeframe not exceeding 15 years after the power plant has started its operation» (Article 3 paragraph 5). Article 4 lays down the application principles for the sale of electricity. Article 5 paragraph 1 regulates that «the enterprise is obliged to obtain all kinds of permissions, approvals and licences required by this law and the other legislation.» To meet the costs of waste management and the cost of dismantling operations of the nuclear power plant within the National Radioactive Waste Account and Decommissioning accounts, paragraph 2 provides an arrangement formed by *ETKB* and the Treasury. After the operation period the nuclear power plant has to be decommissioned and dismantled (paragraph 3). Insurance for the compensation of any damage that can arise during the construction must be obtained by the enterprise and a contribution of 0.15 cent/kWh (in US Dollars) has to be paid for financial costs concerning transportation, waste management and decommissioning (paragraph 4). With regard to accidents «the 1960 Paris Convention on

Nuclear Third Party Liability, its additional amendments and other national and international liability provisions shall apply» (paragraph 5) [24]. Moreover, the enterprise «must allocate 1 % of its annual revenue to research and development activities» (paragraph 6). Article 6 deals with public participation and investment. Incentives «for investment in technology regarding the power plant to be constructed and the training of operation personnel» may be provided by the Council of Ministers (Article 7 paragraph 1). Concerning the regulatory institution, the Temporary Article 1 regulates that «TAEK shall carry out its duty ... until a new institution which will execute the duty of regulating and inspection of nuclear activities is founded.»

The «constructing and operating criteria» mentioned in Article 3 paragraph 3 of the Law No. 5710 which refer among others to the site selection and licensing conditions were published by TAEK on 19 December 2007 on the basis of the Law No. 2690 on TAEK as «Criteria to be Met by Investors Who Will Construct and Operate Nuclear Power Plants» [25]. For technical nuclear safety requirements the criteria refer to 1) nuclear safety, 2) licensing, 3) the reactor type, 4) the plant life-time, 5) the proven technology, 6) the fuel technology, 7) the localization, 8) the operational record and 9) the electrical power. The criteria's main subject of nuclear safety reads as follows: «The nuclear power plant should include up-to-date and proven technological improvements. It should comply with the international norms, especially the norms of the *International Atomic Energy Agency*. Design features that consider preventive measures to reduce radiological consequences against accidents that fall under the category of "severe accidents" shall be taken into account during evaluation» combined with licensing requirements: «The nuclear power plant shall comply with the up-to-date nuclear safety regulation effective in the designer's country, except for site-related requirements and conditions. A licensed power plant, currently under operation and representing the most recent example of the same technology, shall be presented as a reference plant. In case there is no operational reference, a representative of the same technology that has been approved or authorized for construction by a regulatory body shall be presented as the reference. Turkish legislation related to licensing, and conditions that will be requested by the national nuclear regulatory body are reserved. ... The requirements of national legislation and conditions that may be requested by TAEK are reserved and it is emphasized that TAEK is the final authority for any decision regarding licensing. Regulations related to nuclear safety, which will form part of the

basis for TAEK's decisions during licensing, in order of priority, are national regulations and the *International Atomic Energy Agency* regulations given in "Fundamentals" and "Requirements" of Safety Standards Series.» The reactor types taken into consideration may only be «pressurized heavy water reactors that utilize natural uranium and pressurized light water and boiling light water reactors that utilize enriched uranium.» The reactor type has to be a «widely used in the world» and «proven and reliable». The design life-time shall be at least 40 years and the reactor shall be technologically proven, i.e. that only 2nd and 3rd generation nuclear power plants are possible. Moreover «The fuel technology shall be proven» and «The operational record of the power plant technology will be taken into consideration» because it is important to demonstrate the performance of the technology and therefore «The operational record shall include annual frequency and period of planned/unplanned shutdowns, load factor, availability, produced energy and similar parameters». Finally it is required that the «net guaranteed electrical output of each unit of the nuclear power plant shall be greater than 600 MWe.»

Finally, a regulation was published in March 2008 with reference to Article 3 paragraph 3 of the Law No. 5710 concerning «the procedures and principles regarding the selection criteria for competing enterprises, the selection of the enterprise, site selection, licensing conditions, incentives regarding the infrastructure, the duration of the selection process, fuel supply, generating capacity and the amount, duration and unit cost of the energy» (Article 1) [26]. This regulation does not deal with nuclear safety topics.

3. Nuclear legislation, radioprotection regulations and technical requirements to ensure nuclear safety of nuclear power plants in Turkey

Subsequent to Law No. 5710 of 9 November 2007, the «Criteria to be Met by Investors Who Will Construct and Operate Nuclear Power Plants» of 19 December 2007 and the Regulation of 10 March 2008, a comprehensive norm setting process, especially on nuclear safety, quickly developed. These determinations in 2007 and 2008 also included the introduction of energy economics aspects of nuclear energy in Turkey and were aligned on the tendering procedure, the competition to find a foreign builder and operator for the first nuclear power plant in Turkey. Nowadays, there are extensive regulations on nuclear safety and radiation protection in Turkey. Turkey

ratified important international treaties. However, the codification period and the shaping of safety regulations are still to be completed.

The Convention on Nuclear Safety of 17 June 1994 entered into force in Turkey on 24 October 1996 [27]. The IAEA safety standards/requirements/guidelines [28] are therefore de facto binding for Turkey. With regard to the standards and requirements this is already recognized in the «Criteria to be Met by Investors Who Will Construct and Operate Nuclear Power Plants» (No. 2 c). For nuclear safety, the international legal framework consists further of, above all, the COUNCIL DIRECTIVE 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations [29], which Turkey has to transpose as *acquis communautaire* in the course of the EU accession process [30].

The Turkish national law is based on the Constitution [31]; laws, which are enacted by the parliament; decrees (ordinances), which are passed by decisions of the Council of Ministers, and regulations (ordinances), which are adopted as a rule by the responsible ministry. Inferior to these laws, in the material sense, directives and guides exist as sub-legislative rules, which exhibit within the hierarchy of rules the lowest norms, but provide the broadest density of details, and which already display fundamental significant technical specifications for technical safety of nuclear power plants in Turkey [33].

The licensing of nuclear power plants has been regulated since 1983 in the Decree on Licensing Nuclear Installations [34]. Three licensing phases are foreseen (Article 8): Site license (Articles 9 – 12), construction license (Articles 13 – 21) and operating license (Articles 22 – 35). The construction license is given in 2 steps: limited work permit and construction license (Article 13). The steps for the operating license are the commissioning permit, fuel loading and pre-operational test permit and finally full power operating permit and operating license (Article 22). The applicant for a license has to submit documents and reports in order to demonstrate that nuclear safety will be ensured (Articles 6, 9, 14, 23, 26, 29). For the grant of the licenses general conditions are regulated and specific conditions may be given (Articles 12, 18, 21, 32). The Advisory Committee on Nuclear Safety examines the documents and reports and gives advice to TAEK which, after evaluation, issues its decision (Articles 4, 5, 10, 11, 15, 16, 19, 24, 27, 30). Revocation of the operating license is subject of Article 35, the permission to re-start operation together with the need for a permission for modifications at the installation is subject of Articles 54 and 55.

After entry into force of Law No. 5710 (2007) the Decree on Licensing Nuclear Installations (1983) was specified in 2012 by the Directive on Determination of Licensing Basis Regulations, Guides and Standards and Reference Plant for Nuclear Power Plants [35], which is based on elements of the «Criteria to be Met by Investors Who Will Construct and Operate Nuclear Power Plants» of 2007. «The objective of this directive is to identify principles and processes for determination of regulations, guides and standards as well as selection of a reference plant for the licensing of nuclear power plants by Turkish Atomic Energy Authority» (Article 1), while Article 5 states as principles: «(1) A complete list of regulations, guides and standards forming the licensing basis for the plant shall be determined at the beginning of the licensing process in accordance with the provisions of this directive. (2) A nuclear power plant representative of the plant, for which the license application has been made, shall be selected as reference plant at the beginning of the licensing process in accordance with the provisions of this directive.» Article 6 paragraph 1 states that the «owner shall prepare a complete list of regulations determined in accordance with the provisions of the second clause of this article as well as of guides and standards, to be applied in the licensing process, together with a report (Annex I) containing information on the preparation process of the list and indicating its conformance to this directive, and submit to the Authority for approval»; paragraph 2 is decisive for the demonstration and the evaluation of nuclear safety: «The order of priority of the regulations to form the licensing basis is as follows: a) Regulations of The Republic of Turkey, b) IAEA Nuclear Safety Series documents under the categories of “safety fundamentals” and “safety requirements,” c) In the areas deemed not adequately covered by subparagraphs (a) and (b), nuclear safety regulations in the Vendor Country, in force as of a date approved by the Authority.» Moreover it is required for «safety related issues deemed not adequately covered by regulations mentioned in subparagraphs (a), (b), and (c), a third country regulation conforming to relevant IAEA safety guides or to the design of the plant, for which the license application has been made.» The procedure of proposing a reference plant is laid down in Article 7 paragraph 1: «The Owner shall, within 3 months upon recognition as such in accordance with Article 6 of the Decree, propose a nuclear power plant in operation as reference plant that represents the plant, for which the license application has been made. If there is no such plant in operation, a plant of the same technology that has been licensed upon a comprehensive nuclear safety assessment by a competent

nuclear regulatory body and is under construction may be proposed.» The Directive deals also with procedures for decisions to be taken by TAEK.

Nuclear safety is substantially shaped by the interplay of human/technology/organization (HTO) which corresponds essentially with the following rules and regulations. Technical requirements are laid down particularly by the Regulation on Specific Principles for Safety of Nuclear Power Plants (2008), the Regulation on Design Principles for Safety of Nuclear Power Plants (2008), the Regulation on Nuclear Power Plant Sites (2009) and the Guide on Specific Design Principles (2012). The Regulation on Specific Principles for Safety of Nuclear Power Plants [36] has in view (Article 1), «to determine the safety principles to be complied by the authorised person in nuclear power plants to achieve the nuclear safety objectives defined by the Authority» (Authority means TAEK). The definitions (Article 4) make evident that the regulation not only deals with technical matters (accident conditions, anticipated operational occurrence, beyond design basis accident, design basis accident, normal operation) but also focuses on organizational aspects (accident management, operating organization). Article 4 refers with regard to technical safety matters especially on plant states (accident conditions and beyond design basis accidents) to the IAEA Glossary [37]. Details on Site evaluation (External factors affecting the site, Radiological impact of the plant, Feasibility of emergency plans und Ultimate heat sink) are specified in Articles 5 – 8, on Design, Manufacture and Construction (General Design Basis, Quality assurance in design, Proven technology, Design features, Safety assessment of design und Provision of quality) in Articles 9 – 14, on Commissioning (Verification of design and construction and of operating and functional test procedures, Collecting baseline data, Pre-operational plant adjustments) in Articles 15 – 18, on Operation (among others with organizational aspects: Organization, responsibilities and staffing, Training, Feedback of operating experience and Quality management in operation) in Articles 19 – 29, on Decommissioning in Article 30 and on Accident Management and Emergency in Articles 31 – 34.

The Regulation on Design Principles for Safety of Nuclear Power Plants [38] serves (Article 1), «to establish safety principles to be followed during the design of nuclear power plants to achieve nuclear safety objectives defined by the Authority» (Authority means TAEK). Articles 5 – 11 deal with General Design Specifications for Nuclear Power Plants (Process control, Safety systems, Reliability targets, Common cause failures, Equipment qualification, Inspectability of safety equipment and Radiation

protection) and Articles 12 – 25 with Specific Design Features of Power Plants (Reactivity control, Reactor core integrity, Automatic shutdown, Heat removal in normal operation, Emergency heat removal, Start-up, shutdown and lower power operation, Reactor coolant system integrity, Confinement of radioactive material, Monitoring of plant safety status, Preservation of control capability, Station blackout, Confining accidents within the design basis, On-site fuel storage and Plant physical protection).

The purpose of the Regulation on Nuclear Power Plant Sites [39] is (Article 1) «to establish the nuclear safety requirements for nuclear power plant to be built on the site.» Article 5 paragraph 1 cites as the main subjects for a site of a nuclear power plant: «a. The effects of natural and human induced external events on the proposed site area. b. Site and site area characteristics that could influence transport of radioactive material to the people and environment. c. Population distribution and intensity, and other site area characteristics which may affect implementation of emergency measures», and paragraph 2 lays clearly down: «If the deficiencies identified in site area evaluation stage regarding these three issues cannot be compensated for by means of design features, protection measures or administrative procedures, the site shall be deemed unsuitable.» Important details are regulated in Article 7 (External events), 8 (Potential impacts of the plant on the site), 9 and 10 (Emergency planning zone and The feasibility of the implementation of the emergency planning measures), 11 (Design basis external event), 12 – 15 (Human Induced External Events), 16 and 17 (Meteorological External Events), 18 (Flood) and 19 – 24 (Geological and Geotechnical External Natural Events).

Finally, the Guide on Specific Design Principles [40] has the objective (Article 1) «to define specific principles to be applied during the design stage of a nuclear power plant.» Specific design principles in Articles 4 – 10 are Levels of Defense in Depth, Plant States and Objectives, Independence Between All Levels of Defense in Depth, Safety and Security Interface, Radiation Protection and Waste Management and External Events (Earthquake and Aircraft Crash). A comparison with IAEA requirements shows that for example concerning design, the IAEA Design Specific Safety Requirements contain further details, respectively provide the elaborated requirements more precisely [41].

Man oriented requirements are laid down in the Regulation on the Basic Quality Management Requirements for Safety in Nuclear Facilities (2007) [42] which is the basis for many Safety Guides for Quality Management Systems [43]. The objective of the Regulation (Article 1) is «to establish

the statutory basis principles and requirements for quality management in order to enhance the safety of nuclear facilities.» The vast catalogue of definitions (Article 4) demonstrates the rather detailed regulation. In particular the Articles deal with Responsibilities, Relations with Authority, Enforcement (5 – 7), Management System (8), Principles (9), Activities (10), Basic Requirements of Quality Management: Quality Management and Exceptions (11, 12), Management: Priority of Safety, Senior Management's Responsibility, Organization Structure and System, Process Management, Grading, Training and Qualification, Nonconformances, Corrective, Preventive and Improving Activities, Document Management and Records (13 – 20), Performance: Design, Procurement, Work, Acceptance Tests (21 – 24) and Assessment: Review and Self-assessment, Independent Assessment (25, 26). The Safety Guides on Assessment or Quality Assurance for Safety in Nuclear Installations referring to the Regulation cover among others the issues of Establishing and Implementing a Quality Assurance Programme, Assessment of the Implementation of the Quality Assurance Programme, Management of Nonconformance Control and Corrective Actions, Management of Document Control and Records, Inspection and Testing for Acceptance, Quality Assurance in Procurement of Items and Services, Quality Assurance in Manufacturing, Quality Assurance in Research and Development, Establishing and Implementing a Quality Assurance Programme in Siting, Quality Assurance in Design, Construction, Commissioning, Operation and Decommissioning and the issue of Determination of Licensing Basis Regulations, Guides and Standards and Reference Plant.

Concerning the aspect of organization the competences and duties of the Regulatory Body beyond licensing are laid down in the Regulation of Nuclear Safety Inspections and Enforcement [44] and the Directive on the Granting of Functions to Inspectors for Nuclear Safety [45]. The regulation distinguishes between planned inspections and reactive inspections, moreover states that «the authority does not have to notice inspections to inspected body» (Articles 7 – 10). The articles on enforcement (19 – 22) refer to emergency measures, the grade of enforcement, resistance to inspections and taking measures on time. The Articles of the Directive cover competence and responsibility (5), the common responsibility of the inspectors (6), their independence and objectivity (7, 8), their qualification and formation (9, 10) and the termination of their competences (12).

Physical Protection and Security matters are regulated [46] as well as subjects of Radiation Protection (Regulation on Ra-

diation Safety) [47]. The regulation on physical protection (2012) aims at laying down the principles for measures to be taken in order to protect nuclear materials and nuclear power plants against sabotage and theft (Article 1). All activities take into account the security culture at the most high level (Article 5). Measures of the physical protection system have to be worked out in a physical protection programme (Article 10). Detailed measures are regulated in Articles 18 – 35. Control, conformity and enforcement are reflected in Articles 36 – 41. The Regulation on Radiation Safety underlines since 2010 in particular the three Basic Principles of Dose Limitation System: Necessity of Applications, Optimization and Dose Limitation (Article 7) and contains Dose limits (Articles 8 – 14). It may therefore actually be in keeping with *EURATOM* basic standards [48] and the *IAEA* Radio Protection Basic Safety Standards [49]. Finally the Regulation on Nuclear and Radiological National Emergency Preparedness of 2000, revised in 2009 should be mentioned [50].

Main institutions to support *TAEK*'s work are: The *Atomic Energy Commission (AEC)* [51], the Advisory Council [52] and the Advisory Committee on Nuclear Safety [53]. Tasks of the *AEC* with high ranked representatives of different ministries are «to set the working principles and programs of *TAEK*, to approve the draft budget for submittal to the Prime Minister, to draft and submit to the Prime Minister laws and decrees related to nuclear field, and to approve the regulations drafted by *TAEK*, to observe and evaluate the studies of *TAEK*, to submit the annual work program and annual work report to the Prime Minister, to submit the necessary arrangements reviewing the organization and posts against the developing needs of the Authority for the approval of the Prime Minister»; the importance of *AEC* is underlined by the fact that «The Prime Minister Presides the *Atomic Energy Commission* meetings whenever he deems necessary.» [54] The Advisory Council «studies on the subjects submitted by the *Atomic Energy Commission* and submit its results and proposals back to the Commission.» [55] The Advisory Committee on Nuclear Safety «performs the duties specified in the Decree on Licensing of Nuclear Installations. The Committee also comments on the work submitted by the Presidency.» [56] Moreover *TAEK* is supported in particular during the licensing process by external experts [57].

Beyond nuclear, radiation protection and technical regulations especially Environmental Impact Assessment (EIA) including public participation [58] and Access to Environmental Information [59] have to be taken into account for the realization of nuclear power plants. Moreover

further licenses may be necessary for nuclear power plants, in particular in the scope of water legislation [60].

4. State and further preparations for the first nuclear power plant with four units in Mersin-Akkuyu and a view to the second nuclear power plant site in Sinop-Inceburun

Akkuyu is situated in the south of Turkey at the coast of the Mediterranean Sea. A site license for the construction and commissioning of a nuclear power plant in Akkuyu was granted already in 1976 by the *Atomic Energy Commission* and is still deemed valid [61]. Afterwards several tenders were organized, but failed [62]. On the basis of Law No. 5710, the Criteria and the Regulation hereto of 2007 and 2008 as well as the in parallel issued safety regulations of 2008 and 2009 [63] a new tender was started on 24 September 2008 by *TETAŞ*, but after the bid of only one competitor (a Russian consortium) finally cancelled on 20 November 2009 [64]. Main steps for the realization of the project were taken in the last 2 years after the start of negotiations between the Governments of the Republic of Turkey and the Russian Federation on 13 January 2010 [65]: «May 12th, 2010: The governments of Turkey and Russian Federation signed an agreement to cooperate for constructing and operating a nuclear power plant. «Agreement between the Government of the Russian Federation and the Government of the Republic of Turkey on cooperation in relation to the construction and operation of a nuclear power plant at the Akkuyu site in the Republic of Turkey» envisaged establishing 4 units of 1200 MWe Russian design VVER reactors in Akkuyu site. July 21st, 2010: The Grand National Assembly of Turkey ratified the Intergovernmental Agreement. Nov. 24th, 2010: The Council of Russian Federation ratified the Intergovernmental Agreement. Dec. 13th, 2010: Russian party established a company, «Akkuyu NGS Elek-trik Üretim A.Ş.» (*APC: Akkuyu Project Company*) to build, operate and decommission the NPP units. Feb. 7th, 2011: *APC* applied to the *Turkish Atomic Energy Authority (TAEK)* for being recognized as an owner, according to the Article 6 of the Decree on Licensing of Nuclear Installations. Feb. 28th, 2011 *TAEK* recognized *APC* as the owner. March 2011: *APC* started site investigations in Akkuyu for updating the site characteristics and parameters according to the national procedures laid out in the Decree on Licensing of Nuclear Installations.» The Agreement of 12 May 2010 [66] is based on the structures of Law No. 5710, the Criteria and the Regulation hereto of 2007 and 2008; therefore the Akkuyu NPP JSC was found as the investor-owner-operator and had to be

recognized as owner by *TAEK* [67]. The wide scope of the Agreement is laid down in Article 3 which refers not only to technical issues including «FUEL, WASTE MANAGEMENT AND DECOMMISSIONING» (Article 12) but also to economic power production and sales matters (Article 10). Matters of the International Nuclear Framework, for example on non-proliferation and physical protection, and nuclear liability are duly reflected in Articles 15 and 16.

The economic and electricity matters stay as follows: The Russian party (Rosatom) shall always hold a share of at least 51 % of the Project Company; *TETAŞ* will buy for 15 years at 12.35 US (dollar) cents/kWh 70 % of the electricity generated by units 1 and 2, respectively 30 % by units 3 and 4; in case of less production the Project Company shall fulfill its obligations by providing the lacking volume of electricity (Article 10 No. 3 and 5 of the Agreement of 12 May 2010) [68]. Economically important for Turkey is the responsibility of the Project Company for the decommissioning and the waste management of the nuclear power plant, while spent fuel shall be taken back for reprocessing by Russia (Article 12 No. 2 and 4); separately the Project Company has to pay 0.15 US-\$/kWh to the account for spent fuel, radioactive waste management and 0.15 US-\$/kWh to the account for decommissioning (Article 10 No. 9) [69].

With regard to the operation of the nuclear power plant in Akkuyu the planning of the construction period (2014 to 2023) aims at a time schedule which fixes first criticality of the unit 1 in 2020 and of units 2 to 4 between 2012 to 2023 [70]. Whether the envisaged support of the regulatory body on regulatory affairs by the Project Company is a comprehensible measure, it may evoke some concerns; but intensive and vast training of personnel for the Project Company seems necessary [71]. The Environmental Impact Assessment (EIA) shall be a precondition only for the construction license; the affirmative decision for EIA is expected for 2013 [72]. Recently (in May and July 2012) tenders were issued by *ETKB* with regard to general legal support and by *TAEK* concerning technical support during the licensing process for the construction license [73]. For the evaluation of safety aspects in the licensing process a legal discussion refers to the importance of taking into account Russian safety requirements for the Russian type of reactor [74].

The second site at Sinop-İnceburun, where nuclear power plants are also to be built and operated in Turkey, is located at the Black Sea coast. A center for nuclear power engineering has been in operation since 12 February 2008 [75]. The Turkish energy minister, *Taner YILDIZ*, stated on 12 May 2012 that the Turkish government intends to promote the project in Sinop [76].

Here, mainly Chinese and Canadian safety technology [77] could play a role.

5. Status on nuclear energy in Turkey, possibilities and necessities for development, outlook

The legal regulations, technical safety provisions and radiation protection instruments corresponding to the construction and commissioning of nuclear power plants in Turkey as an emerging nuclear energy country are being continuously enhanced [78] and should be completed surely with regard to *IAEA*-safety standards [79]. The Turkish government has taken throughgoing steps in the previous 8 years for a «Nuclear New Build» and has established a considerable legal and technical framework for the beginning construction license procedures for the site of Akkuyu [80]: Basics exist for the permission principle, the control principle and the compensation principle, together with the safety principle, the security principle and the safeguards principle, while the independence principle as a guarantor of adequate and impartial control and supervision, which means that the Regulatory Body as a specialized State authority is responsible for the implementation of the legal framework and that a State authority for promotion and a State authority for control exist and are both separated, has to be cleared up [81].

Nevertheless, we worry about the risks regarding the timely achievement of the ambitious construction and commissioning aims for the four nuclear reactors at Akkuyu; these risks should not be underestimated in the light of decades-long unsuccessful tender for choosing the building and commissioning companies. With regard to nuclear safety of the power plants, the system of a «reference plant» and the cumulative compliance demanded by the existing regulation to the guidelines of 1. Turkey, 2. *IAEA*, 3. the country of the nuclear power plant builder, and 4. third states [82], seems to be difficult to enforce. The *IAEA* stipulations are in parts abstractly formulated and can be interpreted therefore during their concrete application. Contradictions or gaps contrary to the systems in the different guidelines could impede the implementation in the course of the complex authorization procedure with regard to safety (first the creation of the application documents by the project company, afterwards the assessment by the Regulatory Body, probably with the assistance of external experts) and even lead to considerable legal uncertainties. In addition, it could be legally dubious whether the mere reference to safety requirements' regulations as a descriptive method in order to guarantee nuclear safety will withstand in Turkish administrative courts' cases and finally in the constitution-

al court's ruling. Linked to this there is a need for fundamental, comprehensive nuclear energy law in which a normative approach for the necessary safety precautions, in the light of the state-of-the-art of science and technology [83], could be standardized and in which regulations for the priority to safety, for periodical safety review and for the activities of Technical Support Organizations (TSO) would be created [84]. Uncertainty may also arise from the generally announced restructuring of the existing Regulatory Body (*TAEK*) [85]. For the further development of the legal and safety framework, a functional proximity of *TAEK* to the Project Company [86] could prove to be risky for the independence and objectivity of the Regulatory Body. Finally, there appears to be a need to clarify the procedure of Environmental Impact Assessment (EIA) in the framework of the approval process on the one hand and the nuclear licensing for the nuclear power plant in Akkuyu on the other hand. In this context, it should be examined how the Aarhus and Espoo Conventions [87] could be anchored and practiced in the Turkish legal system.

The Turkish Government will certainly benefit from the newly initiated cooperation with the European Commission for the future ambitious and consistent steps towards nuclear energy in Turkey [88].

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- [56] Available at <http://www.taek.gov.tr/eng/about-us/acns.html>
- [57] TAEK, Invitation To Tender For Procurement Of Technical Support Services On Regulatory Control During The Construction License Application For Akkuyu Nuclear Power Plant (Anpp): «Turkish Atomic Energy Authority has initiated the process for procurement of technical support services during the review and assessment of construction license application of ANPP according to the procurement by prequalification procedures. The formal invitation has been announced in Public Procurement Bulletin no. 2155 on July 30th 2012», available since 31 July 2012 at [http://www.taek.gov.tr/eng/\(Addendum available since 12 August 2012\)](http://www.taek.gov.tr/eng/(Addendum%20available%20since%2012%20August%202012)). It should be mentioned that neither the Law No. 2690 of 9 July 1982 nor the Decree on Licensing Nuclear Installations of 1983 (footnote 34) explicitly empower TAEK with the competence to provide itself with external support; see on the other hand the preparations for the creation of a Technical Support Unit (Teknik Destekleme Kuruluşu) for the Akkuyu Nuclear Power Plant Licensing process in (only Turkish): TAEK, 2011 YILI FAALİYET RAPORU (available since 23 July 2012 at http://www.taek.gov.tr/belgeler-formlar/sgm/faaliyet_raporlari/TAEK-2011-Y%C4%B11-%C4%B1-Faaliyet-Raporu/), page 47. It could be stated that the existing regulation in Turkey does not establish a system of Technical Support Organizations (TSO). See for example for Germany Section 20 sentence 1 of the German Atomic Energy Act (Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards of December 23, 1959 (Federal Law Gazette I, p. 814), as amended and promulgated on 15 July 1985, last amendment of 24 February 2012): «In the licensing and supervisory procedures ... the authorities in charge may consult authorized experts», and for example for France Article 4 No. 2 last sentence of Loi no. 2006-684 du 13 juin 2006 relative à la transparence et à la sécurité en matière nucléaire (JO of 14 June 2006): L'Autorité de sûreté nucléaire «délivre les agréments requis aux organismes qui participent aux contrôles et à la veille en matière de sûreté nucléaire ou de radioprotection». See also Convention on Nuclear Safety (footnote 20), Article 8 No. 1 and Article 11 No. 2, and EURATOM Directive of 2 July 2009 (footnote 29), Article 5 No. 3 sentence 1 and Article 7.
- [58] A regulation (Çevresel Etki Değerlendirmesi Yönetmeliği, Official Gazette No. 26939 of 17 July 2008) is valid for nuclear power plants (No. 2 b of the list in annex I to the regulation); see (only Turkish) T.C. Çevre Orman Bakanlığı, Çevresel Etki Değerlendirmesi Özel Sektörel Rehberleri, ÇED Rehberi – Nükleer Enerji Santralleri, 2006, available at http://www.csb.gov.tr/gm/dosyalar/belgeler/belge387/Sektorel_rehber_nukleer.pdf. Article 3 lit. j) sentence 2 of the Environment Law (Law No. 2872, Official Gazette No. 18132 of 9 August 1983,

- chan-ged for the last time in 2006) provides TAEK to be competent for environmental affairs with regard to its competences under Law No. 2690 of 1982. See also *Özge Ünver*, LICENSING AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR NPP'S IN TURKEY (at the Technical Meeting on Environmental Issues in Nuclear Power Programmes, Vienna/Austria, 20-23 March 2012).
- [59] See (only Turkish) TÜRKİYEDE ÇEVRESEL BİLGİLENEME HAKKI VE AB DİREKTİFLERİ by Yrd. Doç. Dr. *Necla Akdağ Güney*, available at www.ikv.org.tr/.../turkiyede_cevresel_bilgilerdir...; see also Sinop Nükleer Teknoloji Merkezi (12 Şubat 2008), available (only Turkish) at <http://www.taek.gov.tr/belgeler-formlar/func-directinfo/97/>, slice 44.
- [60] See for water aspects for example Sinop Nükleer Teknoloji Merkezi (footnote 59), slice 37.
- [61] IAEA (footnote 5), chapter 2.1.1, *Özge Ünver* (footnote 58), slice 4, *Serhat Köse*, Recent Status of Nuclear Program in Turkey (at the Workshop on Introduction of Nuclear Power Programmes: Management and Evaluation of a National Nuclear Infrastructure, Vienna, 8 – 11 February 2011), slice 10. It should be mentioned that the Decree on Licensing Nuclear Installations (footnote 34) does not provide transition regulations for site licenses granted before entry into force of the decree in 1983.
- [62] IAEA (footnote 5), chapter 2.1.1, *Venetka Tzocheva*, Akkuyu NPP – the first Turkish NPP (presentation at Varna 30-01 June 2012), slice 6, *Salih Sarı*, A Review of Akkuyu NPP Project in Turkey After Fukushima Daiichi Accident (at The Technical Meeting on Evaluation Methodology of the Status of National Nuclear Infrastructure Development and Integrated Nuclear Infrastructure Review (INIR), 18-20 June 2012, Vienna, Austria), slice 2, concluding: «Tenders were not successful in Turkey».
- [63] Footnotes 22, 26, 36, 38, 39.
- [64] IAEA (footnote 5), in chapter 2.1.1 the last three paragraphs.
- [65] See TAEK, Akkuyu Nuclear Power Plant, available at <http://www.taek.gov.tr/eng/services/206-akkuyu-nuclear-power-plant/789-akkuyu-nuclear-power-plant.html>, and Sinop Nükleer Teknoloji Merkezi (footnote 59), slices 11 – 40, T.C. Enerji ve Tabii Kaynaklar Bakanlığı, Nükleer Santraller ve Ülkemizde Kurulacak Nükleer Santrale İlişkin Bilgiler, Nükleer Enerji Proje Uygulama Dairesi Başkanlığı, Yayın No. 1, 2011, available (only Turkish) at http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=nukleerenerji_EN&bn=224&hn=&nm=40717&id=40738, TAEK, 2011 Yılı Faaliyet Raporu (footnote 57), pages 47 and 48, *Venetka Tzocheva* (footnote 62), slice 7. At the beginning of September 2012 IAEA evaluated TAEK's Akkuyu site conditions and investigation studies positively (see – only Turkish – <http://www.enerjiport.com/2012/09/04/akkuyu-nukleer-tam-not-aldi/>).
- [66] AGREEMENT BETWEEN THE GOVERNMENT OF THE REPUBLIC OF TURKEY AND THE GOVERNMENT OF THE RUSSIAN FEDERATION ON COOPERATION IN RELATION TO THE CONSTRUCTION AND OPERATION OF A NUCLEAR POWER PLANT AT THE AKKUYU SITE IN THE REPUBLIC OF TURKEY, Official Gazette No. 27648 of 21 July 2010 and No. 27721 of 6 October 2010 (with English version); on 6 August 2009 Turkey and Russia had concluded the «Agreement between the Government of the Republic of Turkey and the Government of the Russian Federation for Cooperation in the Use of Nuclear Energy for Peaceful Purposes» (Official Gazette No. 27844 of 12 February 2011), available at <http://www.taek.gov.tr/eng/international/agreements.html>. Turkish Constitutional Court's ruling of 1 June 2012 upholds conformity of Law No. 6007 of 15 July 2010 (Agreement of 12 May 2010) with the Constitution.
- [67] Article 5 of the Agreement; *K.J. Chechenov*, BOO educational component: the Turkish case, slices 2, 3; see also www.akkunpp.com. Akkuyu NPP JSC is a Turkish Company Incorporated.
- [68] *Serhat Köse* (footnote 61), slices 9, 12.
- [69] See *Serhat Köse* (footnote 61), slices 11, 12, *Gürkan Kumbaroğlu*, Türkiye Açısından Nükleer Enerji Ekonomisi, 2011, concludes that the Agreement is economically positive for Turkey and that Russia has taken over all risks (page 105). See also Article 5 paragraphs 2 and 4 of Law No. 5710 (footnote 22).
- [70] *Salih Sarı* (footnote 62), slice 10, *Venetka Tzocheva* (footnote 62), slices 12, 13.
- [71] *K.J. Chechenov* (footnote 67), slices 2, 3, 8.
- [72] *Özge Ünver* (footnote 58), slices 26, 27
- [73] See *Enerji ve Tabii Kaynaklar Bakanlığı Nükleer Enerji Proje Uygulama Dairesi Başkanlığı*, AKKUYU NÜKLEER GÜÇ SANTRALİ PROJESİNE DAİR HUKUK DANIŞMANLIĞI HİZMETİ ALINACAKTIR, İhale Kayıt Numarası: 2012/39807, and TAEK, Invitation To Tender of 30 July 2012 (footnote 57).
- [74] See *Ali Rıza Aydın*, Akkuyu nükleer güç santraline hukuksal bir bakış, available (only Turkish) at <http://haber.sol.org.tr/yazarlar/ali-riza-aydin/akkuyu-nukleer-gucsantraline-hukuksal-bir-bakis-54626> and at <http://enerjiinstitusu.com/category/konvansiyonel-enerji/nukleer-enerji-konvansiyonel-enerji/>, *Uluslararası İlişkiler ve Stratejik Analizler Merkezi*, Türkiye'ye Teklif Edilen Rus Nükleer Santrali ve Ulusal Nükleer Santral Önerisi (6 January 2009), available (only Turkish) at <http://www.turksam.org.tr/a1560.html>. See also the Agreement between the Government of the Republic of Turkey and the Government of the Russian Federation for Cooperation in the Use of Nuclear Energy for Peaceful Purposes (footnote 66) and the recent announcement on cooperation between Rosatom and Areva (Areva, Communiqué de presse du 18 juillet 2012: «AREVA et ROSATOM examinent un renforcement de leur coopération»).
- [75] See Sinop Nükleer Teknoloji Merkezi (footnote 59).
- [76] See *Turkish Radio and Television Corporation Official Web Site* of 12 May 2012 (footnote 10), available (only Turkish) at <http://www.trthaber.com/haber/ekonomi/turkiye-enerji-ataginda-40524.html>
- [77] See for China <http://enerjiinstitusu.com/2012/04/13/cinin-nukleer-enerjisinitiyalim/> and for Canada <http://enerjiinstitusu.com/category/konvansiyonel-enerji/nukleer-enerji-konvansiyonel-enerji/>
- [78] See TAEK, 2011 Yılı Faaliyet Raporu (footnote 57), pages 45 – 50, and TAEK, Taslak Mevzuat (Draft Regulations and Forms), available (only Turkish) at <http://www.taek.gov.tr/belgeler-formlar/mevzuat/taslak-mevzuat/>
- [79] See List of all valid Safety Standards, available at <http://www.ns.iaea.org/standards/documents/pubdoc-list.asp?s=11&l=96>
- [80] See footnotes 65, 73.
- [81] See *Norbert Pelzer*, Legal Issues Associated with Preparing for a Nuclear Energy Programme, in: International Ministerial Conference on Nuclear Energy in the 21st Century, Beijing, 20 – 22 April 2009, pages 2 – 4, available at http://www-pub.iaea.org/MTCD/publications/PDF/Pub1420_web.pdf, and *Norbert Pelzer*, Nuclear New Build – New Nuclear Law?, in: Nuclear Law Bulletin No. 84 (Volume 2009/2), pp. 5 et seq. With regard to the independence of the Regulatory Body, SABAH newspaper of 24 December 2005 reported that in 2006 TAEK would be restructured by creating a new *Turkish Atomic Regulatory Authority*, while TAEK would be the Research Authority, and ZAMAN newspaper of 14 May 2011 published that the Council of Ministers deliberated to split up TAEK in Research Centers and Institutes on the one hand and Atomic Regulatory Authority on the other hand; see also NEA Nuclear Law Bulletin No. 2/2009 (footnote 19), page 109 lit. d).
- [82] See list annexed to the tender of 30 July 2012 (footnotes 43, 57). Moreover the nuclear safety requirements are still developing; see for example *M. Bukrinski* (Honorary Energy Expert of Russia, SEC NRS), Logic of the safety requirements development for nuclear power plants in Russia, in the Russian journal Nuclear and Radiation Safety No. 2, 2010, pages 3-7 (in Russian).
- [83] See Section 7 paragraph 2 No. 3 of the German Atomic Energy Act (footnote 57): «the necessary precautions have been taken in the light of the state-of-the-art of science and technology to prevent damage from the erection and operation of the installation», and *Gerald Hennenhöfer/Horst Schneider*, 50 Jahre Atomgesetz – Eine Zwischenbilanz, in: *Verfassung Umwelt Wirtschaft (Festschrift für Dieter Sellner)*, 2010, pp. 347 et seq., in particular pages 350 – 357.
- [84] See the remarks in footnote 19. For the priority to safety see Article 10 of the Convention on Nuclear Safety (footnote 20) and the EURATOM Directive of 2009 (footnote 29), Article 6 No. 4; until now the priority to safety is accentuated in Turkish law for example with regard to Quality Management Requirements in Article 13 of the Regulation of 2007 (footnote 42). For the issue of TSO see the remarks in footnote 57 and *Dieter Sellner/Gerald Hennenhöfer/Anselm Schaefer/Michael Sailer*, Expert's Report The Role of the Independent Expert Organisations and the Risks Related to Changing the Supervision Process, 2007, pp. 7 – 52, dealing with the approaches taken by Germany, France, Sweden and the USA.
- [85] See Law No. 5710 (footnote 22), Provisional Article 1, and the remarks on separation of TAEK in footnote 81.
- [86] *K.J. Chechenov* (footnote 67); see in particular the aspect mentioned in footnote 71.
- [87] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, adopted on 25 June 1998 in Aarhus (Denmark), and Convention of Environmental Impact Assessment in a Transboundary Context, done at Espoo (Finland), on 25 February 1991.
- [88] See *European Commission*, Memo of 14 June 2012, Enhanced EU-Turkey energy cooperation, No. 5. «Nuclear safety and radiation protection».