Turkey's Way to Nuclear Energy – An Example for a Newcomer's New Build (Page 584)

E. Ercan and H. Schneider

The government of the Republic of Turkey acted very determined for several years to put the first nuclear power plant in Turkey to full operation by 2020. The economic growth of Turkey, which is far higher than the EU's average, requires a modern and reliable energy supply for the population and businesses. The Turkish government's energy policy and energy economics decisions for the realization of the necessary steps to achieve the energy targets are implemented quickly. In this process, the reduction of the dependence on energy imports plays a significant role. Hereunto, the build-up of nuclear power in Turkey is to be used. Lower ecological disadvantages than fossil forms of energy production and higher production reliability than thermal or hydroelectric power plants are attributed to nuclear power plants. The site for the first nuclear power plant in Mersin-Akkuyu has been determined and the site is being scientifically and systematically explored, so that the government-selected Russian partner can construct and operate the facility. The tender for the second planned nuclear power plant in Sinop-İnceburun is being prepared. The energy economics legislative and especially the nuclear and radiation protection regulation systems, including the so-called sub-legal nuclear regulations for commercial nuclear power plants, are being developed. In particular, the required safety standards for the construction and operation of nuclear power plants need to be further elaborated. For these procedures, the required personnel for the authorities and experts have to be intensively trained and prepared for their practical tasks. Considering this background and subsequent to the report in atw 2007, 15 et seq. above all the safety aspects of nuclear power plants in terms of their planning, site selection, construction and operation will be examined. Without a reliable legal framework and sound technical regulations rules the licensing process for construction and operation will hardly be accomplished, and the meanwhile supervision will not be performed as efficiently which may impair the provision of safety. The path, chosen so far in Turkey will be shortly compared with essential fundamentals in countries which have a long experience with the peaceful use of nuclear energy. In summary, it cannot be reliably predicted, whether the ambitious plans for nuclear energy are being appropriately implemented in time by the operator and the responsible nuclear authority in Turkey.

Cost Effective Decommissioning and Dismantling of Nuclear Power Plants (Page 593)

K. Wasinger

As for any large and complex project, the basis for cost effective decommissioning and dismantling of nuclear power plants is established with the development of the project. Just as its construction, dismantling of a nuclear power plant is similarly demanding. Daily changing situations due to the progress of construction – in the present case pro-gress of dismantling – result in significant logistical challenges for project managers and site supervisors. This will be aggravated by the fact that a considerable amount of the re-moved parts are contaminated or even activated. Hence, not only occupational health, safety and environmental protection is to be assured, employees, public and environment are to be adequately protected against the adverse effect of radioactive radiation as well.

Work progress and not least expenses involved with the undertaking depend on adherence to the planned course of actions. Probably the most frequent cause of deviation from originally planned durations and costs of a project are disruptions in the flow of work. For being enabled to counteract in a timely and efficient manner, all required activities are to be comprehensively captured with the initial planning. The effect initial activities may have on subsequent works until completion must particularly be investigated. This is the more important the larger and more complex the project actually are.

Comprehensive knowledge of all the matters which may affect the progress of the works is required in order to set up a suitable work break-down structure; such work break-down structure being indispensable for successful control and monitoring of the project. In building the related organizational structure of the project, all such stakeholders not being direct part of the project team but which may potentially affect the progress of the project are to be considered as well.

Cost effective and lost time injury free dismantling of decommissioned nuclear power plants is based on implementing lessons learned from previous experience and on consistent application of methods and processes applied in new builds and large projects for modernization and back-fitting of existing plants.

Human Based Roots of Failures in Nuclear Events Investigations (Page 596)

St. Ziedelis, M. Noel and M. Strucic

This paper aims for improvement of quality of the event investigations in the nuclear industry through analysis of the existing practices, identifying and removing the existing Human and Organizational Factors (HOF) and management related barriers. It presents the essential results of several studies performed by the European Clearinghouse on Operational Experience. Outcomes of studies are based on survey of currently existing event investigation practices typical for nuclear industry of 12 European countries, as well as on insights from analysis of numerous event investigation reports.

System of operational experience feedback from information based on event investigation results is not enough effective to prevent and even to decrease frequency of recurring events due to existing methodological, HOF-related and/or knowledge management related constraints. Besides that, several latent root causes of unsuccessful event investigation are related to weaknesses in safety culture of personnel and managers. These weaknesses include focus on costs or schedule, political manipulation, arrogance, ignorance, entitlement and/or autocracy. Upgrades in safety culture of organization's personnel and its senior management especially seem to be an effective way to improvement. Increasing of competencies, capabilities and level of independency of event investigation teams, elaboration of comprehensive software, ensuring of positive approach, adequate support and impartiality of management could also facilitate for improvement of quality of the event investigations.

The AFR – an Approved Network of Research Reactors (Page 602)

G. Hampel

AFR (Arbeitsgemeinschaft für Betriebs- und Sicherheitsfragen an Forschungsreaktoren) is the German acronym for "Association for Research Reactor Operation and Safety Issues" which was founded in 1959. Reactor managers of European research reactors mainly from the German linguistic area meet regularly for their mutual benefit to exchange experience and knowledge in all areas of operating, managing and utilization of research reactors. In the last 2 years joint meetings were held together with the French association of research reactors *CER (Club d'Exploitants des Réacteurs)*. In this contribution the *AFR,* its members, work and aims as well as the French partner *CER* are presented.

CER: Research Reactors in France (Page 604)

J. Estrade

Networking and the establishment of coalitions between research reactors are important to guarantee a high technical quality of the facility, to assure well educated and trained personnel, to harmonize the codes of standards and the knowledge of the personnel as well as to enhance research reactor utilization. In addition to the European co-operation, country-specific working groups have been established for many years, such as the French research reactor *Club d'Exploitants des Réacteurs (CER)*. It is the association of French research reactors representing all types of research reactors from zero power up to high flux reactors. *CER* was founded in 1990 and today a number of 14 research reactors meet twice a year for an exchange of experience.

Germany's Most Modern Research Reactor, the Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II) (Page 605)

H. Gerstenberg and A. Kastenmüller

The *Technische Universität München (TUM)* is operating on its campus in Garching Germany's most modern research reactor, the *Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II)*. It was built and commissioned in collaboration between the *TUM* and the *Siemens/Areva* company; its nuclear commissioning was completed in 2004. Since 2005 *FRM II* served the scientific community in 29 reactor cycles and more than 1,580 full power days without significant problems or even incidents.

The *FRM II* is a heavy water moderated, light water cooled research reactor exhibiting a thermal power of 20 MW. Its central component is the single cylindrical fuel element which forms the reactor core.

The High Flux Research Reactor at the Laue-Langevin Institute (ILL) (Page 607)

H. Guyon and P. Geltenbort

The *Laue-Langevin Institut (ILL)* is one of the top neutronic research installations in Europe. It is

managed by France, Germany and Great Britain. The *ILL* operates the HFR (High Flux Reactor), the world's most intense neutron source and delivers neutron beams to 34 high technology scientific instruments. Due to its unique highly compact fuel element and the excellent thermo-hydraulic conditions, the reactor delivers thermal neutron flux of 1.5 x 10^{15} n cm^{-2} s^{-1} with a thermal power of 58.3 MW.

Reactor Institute Delft (Page 608)

A.R. Groenhof, A.A.R. Wetzel and H.T. Wolterbeek

In the Netherlands, the *Reactor Institute Delft (RID)* is the academic center for radiation-related research and education. The institute's research reactor, the *Hoger Onderwijs Reactor (HOR)* is a light water reactor of the pool type with a thermal power of 2 MW. Construction of the HOR successfully completed in 1963. The reactor is currently operated around the clock, 5 days/week, 45 weeks per year at a thermal power level of 2 MW, with an average thermal flux of about 2x10^{13} n cm^{-2} s^{-1}. For the HOR reactor core nuclear fuel elements of the MTR type are used. The reactor is used as a source of neutrons, positrons, gamma rays and radioisotopes.

The Jules Horowitz Reactor: A New High Performances European MTR (Material Testing Reactor) with Modern Experimental Capacities (Page 610)

J. Estrade

European Material Testing Reactors (MTR) have provided an essential support for nuclear power programs over the last 40 years within the *European Community*. However, thereactors will be more than 50 years old in this decade and will face increasing probability of shut-down.

The *Jules Horowitz Reactor (JHR)* is a new Material Testing Reactor currently under construction at *CEA Cadarache Research Centre* in the south of France. It will represent a major research infrastructure for scientific studies dealing with material and fuel behaviour under irradiation. The *JHR* will contribute also to secure the production of radioisotope for medical application.

JHR building is going on in a nominal way and its first criticality is scheduled for the end of 2016.

The Research Reactor BER II at the Helmholtz-Center Berlin (Page 611)

H. Krohn

For basic and application-oriented research assignments the *Helmholtz-Center Berlin (Helmholtz Zentrum Berlin – HZB)* runs a research reactor that operates as a source of neutron beams for a wide range of scientific investigations. At the end of the 1980th the *BER II* was completed renewed and fitted with new experimental facilities. The *BER II* is a light water cooled and moderated swimming pool type reactor to be operated at 10 MW thermal power. Six neutron guides deliver cold neutrons from the cold moderator cell to a neutron guide hall adjacent to the experiment hall. With its 24 experimental stations, experimenters at *HZB* have practically all neutron scattering or neutron radiography techniques at their disposal.

The BR2 High-Flux Reactor (Page 612)

B. Ponsard

The *BR2* reactor is a 100 MW_{th} High-Flux "Material Testing Reactor" which first became operational in 1963 and has since been refurbished in 1995 to 1997. It is operated by the *Belgian Nuclear Research Centre, SCK CEN,* in the framework of programmes related to the development of structural materials and nuclear fuels for fission and fusion reactors. Serious maintenance efforts are currently made by *SCK CEN* to secure its safe operation until at least 2023. This would guarantee the continuity of the activities in which the *BR2* reactor is involved through its replacement by an Accelerator Driven System (ADS), MYRRHA, scheduled to be operated by *SCK CEN* from 2023.

The Research Reactor TRIGA Mark II of the Johannes Gutenberg-University Mainz (Page 614)

G. Hampel and K. Eberhardt

The *TRIGA Mark II* research reactor of the *University of Mainz* was built in the 1960ies on the initiative of *Fritz Straßmann,* co-discoverer of the fission, at that time the director of the *Institute for Inorganic and Nuclear Chemistry*. On August 3rd, 1965 the *TRIGA Mainz* reached first criticality with the insertion of the 57th fuel element in the reactor core. Two years later, in April 1967, the Nobel Prize laureate *Otto Hahn* initiated the first of now more than 18,000 pulses at the official inauguration. Since then, the *TRIGA Mainz* has operated without failure about 200 days per year. The *TRIGA Mainz* can be operated in the steady state mode at power levels ranging up to 100 kW_{th}, depending on the requirements of the different experiments. Pulse-mode operation is also possible.

FRJ-2 Research Reactor (DIDO) at Forschungszentrum Jülich (Page 616)

S. Raffel and G. Damm

FRJ-2 is a research reactor of the British DIDO/PLUTO series, which uses heavy water (D_2O) in a sealed tank as a moderator and for cooling. In November 1962, it went into operation with a thermal output of 10 MW. The exhaustion of available reserves led to the output being increased in 1967 to 15 MW, and after structural alteration measures to 23 MW in 1972.

Since final shutdown in May 2006, the *FRJ-2* research reactor has been in the post-operational phase. The application for decommissioning and dismantling the *FRJ-2* research reactor in one step was submitted to the nuclear licensing authority in North-Rhine Westphalia in 2007. *FRJ-2* will be dismantled autonomously by *Forschungszentrum Jülich*.

Training Reactors in Germany (Page 617)

W. Hansen

Training reactors contribute to the maintenance and enhance nuclear know-how and competence. Even today with the current political circumstances in Germany, characterized by phasing out nuclear power, there is considerable demand for young engineers and scientists in the nuclear sector. The demand is driven by retirement of staff members at existing NPP and nuclear industrial suppliers, decommissioning of nuclear facilities, continued work in the field of basic nuclear physics research, nuclear engineering, radiation protection, waste disposal, nuclear medicine, and the regulatory bodies, technical inspection organizations or international organizations. For students, the training reactors in Stuttgart, Furtwangen, Ulm and Dresden provide a unique opportunity to get a hands-on experience of neutronics in addition to their theoretical education.

Conference Report: Fourth Review Meeting of the Parties of the Joint Convention (Page 620)

P. Brennecke

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the first legal instrument to directly address these topics on a global scale, was opened for signature 29 September 1997. It entered into force 18 June 2001.

The Convention calls for triannual review meetings of the Contracting Parties. Each Contracting Party is required to submit a national report to each review meeting that addresses measures taken to implement each of the obligations of the Convention. The first review meeting took place in 2003.

The 4th review meeting of this Convention took place from 14 to 23 May 2012 at the *International Atomic Energy Agency (IAEA)* Headquarter in Vienna/Austria.

2012 Annual Meeting on Nuclear Technology: Topical Sessions – Part 2 (Page 622)

Summary report on the Topical Session of the Annual Conference on Nuclear Technology held in Stuttgart, 22 to 24 May 2012:

- Robustness of European nuclear power stations against external hazards exceeding the design basis

Section Reports: 2012 Annual Meeting on Nuclear Technology – Part 2 (Page 624)

Summary report on 2 out of 12 sessions of the Annual Conference on Nuclear Technology held in Stuttgart, 22 to 24 May 2012:

- Fusion technology (Section 9),
- Radiation protection (Section 11) ■

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