

THE REGULATORY ROLE OF THE HUNGARIAN GEOLOGICAL SURVEY IN RADIOACTIVE WASTE MANAGEMENT

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ABSTRACT

The Hungarian Geological Survey has sound and well-defined regulatory rights in radioactive waste management and in the nuclear field in general. This is not only due to long-standing traditions of geological research institutes in the country but the perception of law-makers that geology is the "down to earth" science to study and judge the most complex surface and subsurface processes as natural external factors related to long-term safe operation of nuclear facilities.

In this manner the Hungarian Geological Survey is a key-player in the licensing procedures of radioactive waste disposals. Its role is presented by showing the legal base and some recent examples of the field.

INTRODUCTION

Geological research supports many elements of the nuclear fuel cycle as exploration and exploitation of uranium ore, geomechanical and seismic safety of nuclear facilities, screening, siting and characterization of radioactive waste disposals, environmental impact assessments in general, etc. The participation of national geological surveys in these programmes varies a lot. In some countries Surveys are the main contractors, elsewhere they act only as supervisors in the quality assurance programme while in some countries their role is negligible.

The regulatory role of Geological Surveys is rather limited (1). Federal Surveys usually do not have any, the licensee has to apply for the expert opinion of some State Geological Surveys (e.g. in USA, Germany) but the acceptance of their expertise is rather a political than a legal or a scientific question. In this respect the Hungarian Geological Survey is an exception, a unique example worth presenting.

The Hungarian Geological Survey (hereinafter referred to as "Survey") established in 1993 by the XLVIII. Mining Act as a government agency under the supervision of the Ministry of Industry and Trade has wide and sound regulatory rights and related tasks in many fields as environmental, mining, nuclear and construction affairs. The **regulatory measures** are accompanied by **public service** tasks (mostly geoscience data service) and backed up by **research activities** of its financially independent institutes, the 130-year-old Geological Institute of Hungary and the 80-year-old Eötvös Loránd Geophysical Institute. The Survey performs all the above-mentioned three functions in the nuclear field as well, details of the regulatory side are presented hereby.

REGULATORY RIGHTS AND PRACTICE

The Survey's expert authority **rights** are established in the 132/1993. (IX. 29.) Government Decree. This Decree defines the competency of the Geological Expert Authority in licensing procedures by citing the relevant legal acts and gives the general outline that the seven Regional Offices of the Survey should act in the first degree proceedings. Their regulatory area covers generally three counties. In case of declined applications the client can appeal and initiate a second proceeding at the Department of Geological Expert Authority located in Budapest.

The Survey's regulatory **mission** is three-fold:

- to protect the geoenvironment against the unfavorable human impacts (contaminations by hazardous waste, disturbance of natural systems (e.g. groundwater regime or geomechanical stability, destruction of preserved minerals or fossils, etc.));
- to minimise the effects of geohazards (e.g. landslides, earthquakes, liquefaction of soils, natural gas emission, volcanic eruptions) on human environment;
- to protect mineral resources and to promote their sustainable exploitation.

This mission explains the unique position of the Survey which is in halfway between the industrial and the environmental lobbies. The professional, independent attitude is the key that had been keeping this position for so long.

The **object** of the regulatory work is the geoenvironment (lithosphere) which can be defined as the complex totality of all the solid, liquid and gas phases of the Earth's subsurface. The **subject** of this expert activity is the interaction between geoenvironment and human activity in general. This dynamic subject requires high-quality professional work of the geologists supervising the submitted documents.

The regulatory **attitude** of the Hungarian Geological Survey is a **performance-based approach**. This approach and practice involves that no or just a few prescriptive, quantitative standards and requirements are forced and the licensee is required to comply with the given objectives and measures with a certain freedom to achieve (2). The Hungarian law gives way to communication between the licensee and the authorities that is a frequent practice at the Survey.

The total number of cases submitted to and proceeded at the Survey is ca. 2000 per annum. Most procedures are related to mineral exploration, mining and environmental affairs, less expertise was issued in land use planning, nature protection, construction licensing, etc. (3). The spatial distribution of cases reflect the different development of the counties, there are more in the western part of Hungary. The number of expertise issued in the nuclear field is generally less than twenty which is $\leq 1\%$ of the total figure. This small number includes all the nuclear facility, radioactive waste disposal and uranium mining related cases.

While nuclear affairs are small in number, they require special efforts of the Survey's geologists and geophysicists because

- these are the most complex studies, the documentation is voluminous, often extending hundreds of pages;
- an adequate knowledge of radioisotope sciences, domestic regulations, international standards and guidelines is needed;

- a distinguished attention has to be paid to supervision due to public sensitivity and political consequences.

ROLE IN THE NUCLEAR FIELD

The Survey's regulatory **role in the nuclear field is multiple**. It is the **licensing authority** of plans and final reports of geological research related to nuclear facilities in general (nuclear power plants, nuclear research reactors, radioactive waste disposals - IKIM Decree 62/1997. (XI. 26.)) and the **recording authority** of all the nation's mineral resources and reserves including uranium ore reserves as well (Act LXVIII of 1993 on Mining, Government Decrees 115/1993. (VII. 12.) and 132/1993. (IX. 29.)).

The Survey is a licensing **co-authority** in

- establishment, construction, modification and closure of nuclear facilities in general;
- environmental protection licensing of nuclear facilities (reviewing environmental impact studies, performance assessments and audits);
- uranium mining affairs (reviewing exploration plans and reports, annual technical plans, remediation plans, opening and closure plans of mines).

The co-authority role means that the Survey's expertise has to appear in the final decision of the licensing authority (e.g. in that of the Environmental Inspectorate).

The **basic legal act** encompassing and governing the Survey's regulatory activity in radioactive waste management is the Decree of the Minister of Industry, Trade and Tourism 62/1997. (XI. 26.) on the Geological and Mining Requirements for the Siting and Planning of Nuclear Facilities and Radioactive Waste Disposal Facilities in accordance with the Act CXVI of 1996 on Atomic Energy. Since there is no a separate act regulating radioactive waste disposal this Decree had to give the most important definitions (e.g. geological barrier, potential site, institutional control, etc.). It describes the methodology and geological requirements of site selection and characterization, the essential elements of quality assurance and control, the general geological and mining requirements, details of the licensing procedure and in four appendices the special geological requirements for siting of (1) nuclear facilities; (2) deep geological disposal facility for high-level radioactive waste; (3) deep geological disposal facility for low- and intermediate-level radioactive waste; (4) surface and near-surface disposal facility for low- and intermediate-level radioactive waste. A general outline of the factors to be studied during geological research is given as well in the form of a matrix containing all nuclear facilities with a weight number related to the importance of the geological factor.

These regulations were set in harmony with the OECD Nuclear Energy Agency and the International Atomic Energy Agency conventions, standards and guides. The relevant regulations of some countries (e.g. France, Finland, USA, Germany, Japan, etc.) were considered as well.

CASE STUDIES

The radioactive waste-related licensing procedures in which the Survey took part in the recent past or in the present are as follows.

Interim storage facility of spent fuels at Paks Nuclear Power Plant

Disposal of spent fuel assemblies (120/Unit/year) of Paks Nuclear Power Plant is an important factor in its operation (4). Till now, spent fuel was shipped back to Russia after a five-years cooling period. Due to political changes a Modular Vault Dry Store was licensed and commissioned in 1996. The Survey participated in the environmental, construction and operation licensing procedures of the Store.

The Store located in the territory of the Power Plant. It has a passive air-cooling system provided by ventilation stacks. The spent fuel assemblies are stored vertically in carbon steel tubes filled with nitrogen in the reinforced concrete vaults. Each vault is capable to accomodate 450 assemblies.

The geological suitability of the site is moderate because it is set on the Quaternary terrace gravel beds of river Danube characterized by high groundwater level and loose, uncompacted, unamalgamated consistency. The Survey accepted the 0.35 g value for the maximum horizontal acceleration induced by earthquake as a design base and prescribed several engineering geological requirements as changing the uppermost unstable soil layers; using piles for foundation; and to settle a groundwater monitoring system.

Deep geological disposal facility for low- and intermediate level radioactive waste at Üveghuta

Before the 62/1997. (XI. 26.) IKIM Decree had come out the Survey had a co-authority role in licensing the different screening and site characterization phases of low- and intermediate level radioactive waste disposal. The main authority is the sub-committee of the Hungarian Atomic Energy Committee that consists of independent experts. After the Decree came into force the Survey's South Transdanubian Regional Office has to license the exploration plans and to accept the reports of the geological siting phases.

The site investigation programme started in 1993 and followed a step by step procedure (5). After the two desk-top screening phases of 1:500 000 and 1:100 000 scales and the two field study phases three potential sites were designated, one for geological disposal in granodiorite and two for surface disposal in loess. By the beginning of 1997 as a result of on-site drillings and preliminary site-specific safety assessments priority was given to the underground disposal in the granitic terrain at Üveghuta.

The licensing of the final report of the second site characterization phase is under way by the Survey. Together with a safety assessment analysis, this should prove the suitability of the site. The hydrogeological communication of groundwater and meteoric waters in the fractured granite host rock is in the focus of the investigation.

Near-surface disposal facility for low- and intermediate level radioactive waste at Püspökszilág

In the early seventies the increasing amount of institutional radioactive waste required to establish a new, engineered near-surface disposal facility. Geological experts suggested a hill site at Püspökszilág where gently dipping impermeable layers of Oligocene clays provided an ideal host formation under the 10-20 m thick Quaternary loess sequence. However, the realisation of

the plan failed and the concrete storage wells and basins were deepened into the loose, unstable Quaternary sediments.

The Survey reviewed the report submitted for the interim operation licence. It was pointed out that for the final decision a safety assessment study is needed that is inconceivable without a reliable geological model of the disposal site in operation since 1976. The plan of a complex geological research has been submitted to the Survey's Budapest Regional Office. The geological barrier does not seem efficient enough so more attention is paid to the elements of the engineered barriers.

Mecsek Uranium Mine

The Mecsek Uranium Mine was in operation between 1956 and 1996. It had six mining plots (65 km²) which covers 18 Mm³ underground space, 1.5 Mm³ is still open. Its facilities were thirteen shafts, an enrichment plant, two leaching heap piles (on 47 ha area with 400 t U), two tailing ponds (20.3 Mt slurry with 1330 t U) and ten waste rock piles (9.8 Mm³ with 1030 t U). 20700 t uranium ore was exploited, 46 million tons of rock was moved in total (6).

Environmental licensing

As a licensing co-authority the Survey's South Transdanubian Regional Office (hereinafter referred to as "Office") reviewed the preliminary and detailed environmental assessment studies of the mine closure (7). It required quantitative data of uranium, other radioactive elements and their daughter isotopes in form of documented, balanced equations considering exploitation, milling and enrichment activities, export and disposal. The Office asked for the geochemical characterisation of the tailings and slurries (e.g. sulphate, heavy metals, radiochemicals), and for an assessment of how these elements and compounds are fixed or can migrate to the surface or to groundwater reservoirs. The potable groundwater reserves of Pécs and the Neogene aquifer system might be threatened by the radionuclides of the two tailing ponds. The preliminary impact assessment did not study this problem in depth. A detailed study and a hydrogeological monitoring system was prescribed.

According to the recharged groundwater level rise and the high volume of loose underground spaces the Office requested a geomechanical study to assess future surface movements that can jeopardize buildings and other facilities. Additional geomechanical monitoring system was prescribed. The Office criticized the planned design of the soil cover for the leaching heap piles which was appropriate neither from radiation protection nor from erosion protection point of view.

The annual technical plans of exploitation and technical plans of closure and remediation were reviewed by the Office. The Office required to submit the complete mining geological documentation including the maps of the latest operation phase and the maps of the exploration facilities (e.g. boreholes, geophysical profiles, etc.). The Office missed the detailed accounts of mineral resources exploited. Moreover it required to prepare and submit a final summary report of the geological exploration works carried by the Company.

The future of "Alpha" test tunnel

The Boda Siltstone Formation, a potential host rock formation for long-lived, high-level radioactive waste, has been studied in a tunnel of Mecsek Uranium Mine as an underground laboratory since 1993. This pelitic formation of low porosity and permeability underlies the uranium-rich Upper Permian - Lower Triassic red sandstone formation which was exploited in the mine. In cooperation with the Canadian AECL Company the test tunnel was constructed and furnished with the most up-to-date equipments in order to study in situ the hydrogeological, geochemical, mineralogical-petrological and geomechanical properties of the formation.

The annual research reports are generally accepted by the Survey without any serious objections due to the high quality of scientific performance. The future of the underground laboratory depends on the details of closure of the mine because the survival of the two shafts needed for the operation is a financial problem.

CONCLUSIONS

Being the basic and most complex earth science, geology is a base to assess and judge subsurface material processes - including radioisotopic migration processes - that can effect human environment. Understanding this, the Hungarian Parliament and Government gave sound regulatory rights to the Hungarian Geological Survey in many licensing procedures. According to the due professional attitude, the Survey's expert opinions were decisive in many cases. The multiple regulatory functions of the Survey prevail in the nuclear field and especially in the radioactive waste management. This may help to minimize the risk of unfavourable health impacts on present and future populations transferred by the geological media.

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