



# MOVING FORWARD WITH GEOLOGICAL DISPOSAL OF HIGH-ACTIVITY RADIOACTIVE WASTE

– A collective statement of the NEA RWMC

## 推进高强度放射性废物的地质处置

– 核能署/放射性废物管理委员会的共同陈述

The NEA Radioactive Waste Management Committee (RWMC) is a forum of senior representatives from operators and industry, safety authorities, policy makers, and research and development institutions engaged in the management of radioactive materials and waste. With its broad representation and the wide range of external expertise that its members can muster, the RWMC is a uniquely placed international forum to assist OECD countries to address issues concerning the management of radioactive materials and waste. The Committee has underscored the environmental and ethical basis for geological disposal as well as its technical feasibility in a number of previous collective statements. In the intervening time there have been advances and evolving views regarding the relevant methodologies, policies, and decision-making processes, and much further practical experience has accumulated. The Committee expresses hereunder, in a concise form, its collective views on why geological disposal remains an appropriate waste management choice for the most hazardous and long-lived radioactive wastes, on the current status of geologic disposal, on challenges and opportunities to implementation, and on expectations for further developments.

核能署放射性废物管理委员会（以下简称委员会），是一个由营运者和工业界、安全当局、政策决策者及研究开发机构等多方从事放射性材料及其废弃物管理的资深代表组成的论坛，



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由于委员会具有广泛的代表性和深厚的技术背景，使其能够发挥独一无二的作用，帮助经济合作与发展组织成员国处理放射性材料及其废物管理的相关问题。

在此前的多个立场陈述中，委员会强调了地址处置的环境及道德依据，同时也强调了其技术可行性。期间，委员会不仅针对相关的方法论、政策、决策过程等方面提出了不少前瞻性的看法，同时也积累了许多实践经验。在此，委员会拟针对地质处置仍作为大多数有害废弃物及长寿期放射性废物的合理处置方式的理由，目前地质处置现状、其实施所面临的挑战与机会以及未来的展望，提出以下共同的想法：

### *Why is geological disposal appropriate for high-activity, long-lived radioactive waste?*

#### *高强度长寿期放射性废弃物适于地质处置的理由*

Radioactive waste is associated with all phases of the nuclear fuel cycle and with the use of radioactive materials in industrial, medical, research and defense-related applications. All such waste must be managed safely and in a manner that protects humans and their environment.

The most hazardous and long-lived radioactive wastes, such as spent nuclear fuel and high-level waste from fuel reprocessing, must be contained and isolated from humans and the environment for many tens of thousands of years.

Whatever the future of nuclear power in the different countries, it is universally recognized that safe and acceptable disposal solutions must be pursued for existing and projected inventories of high-activity, long-lived radioactive waste from current practices.

A geological disposal system provides a unique level and duration of protection for high-activity, long-lived radioactive waste. The concept takes advantage of the capabilities of both the local geology and the engineered materials to fulfill specific safety functions in complementary fashion providing multiple and diverse barrier roles.

The overwhelming scientific consensus world-wide is that geological disposal is technically feasible. This is supported by the extensive experimental data accumulated for different geological formations and engineered materials from surface investigations, underground research facilities and demonstration equipment and facilities; by the current state-of-the-art in modelling techniques; by the experience in operating underground repositories for other classes of waste; and by the advances in best practice for performing safety assessments of potential disposal systems.

Disposal can be accommodated in a broad range of geological settings, as long as these settings are carefully selected and matched with an appropriate facility design and configuration and engineered barriers.

在核燃料循环的各个阶段，以及放射性材料在工业、医疗、农业、科研以及国防等领域的应用中，都不可避免地产正放射性废物，这些废物必须得到安全处置，以保障人类的健康和环境的安全。

对那些极端有害且长寿期的放射性废物，如乏燃料或核燃料后处理产生的高强度放射性废物，必须加以封存，并与人类和环境相隔离数万年。

不同国家的核能发展前景或有所不同，但针对当前活动已产生或预计产生的高强度长寿期放射性废物的存量，寻求一种安全且可接受的处置方法，是大家的共识。

地址处置系统能对高强度长寿期放射性废物提供特需且长久的安全保障，其概念利用了当地的地质与工程材料等有利条件，形成具有多重性且多样性的安全屏障，使得地质处置系统能以互补的方式实现设施特需的安全功能。

全球性的科学共识是：地质处置在技术上是可行的。该论断可由以下事实得到支持：（1）通过地表调查、地下试验设施或示范设备与设施取出的不同地质成分或工程材料开展的大量实验所积累并验证的数据；（2）目前现代化模拟技术的成果；（3）其他种类废物的地下处置设施的运行经验；（4）对未来潜在地质处置系统所做的最优化安全评估所获得的进展等。

只要当地的地质条件与经过仔细挑选的设施的设计、配置和工程屏障相匹配，地质处置行为可以与各类地质条件相容。

### *Where do we stand with geological disposal in OECD countries?*

#### *针对经济合作与发展组织成员国的地质处置—我们的立场*

Having taken into account significant public and stakeholder involvement, many countries have adopted geological disposal as the reference long-term management solution for their high-activity, long-lived radioactive waste.

Progress towards implementation is evident in a number of countries. For countries that have faced challenges and setbacks with respect to implementation, geological disposal still remains the reference option.

With the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the Safety Standards of the International Atomic Energy Agency, and the recommendations of the International Commission on Radiological Protection there is now a common framework that guides national regulatory oversight and implementation of disposal.

For programmes that are most advanced, implementation of geological disposal builds on a strategy that accommodates continuous learning and includes a willingness to incorporate evolution in technical advances and societal requirements.

The search for, and selection of, a site are critical steps that have proven to be politically and socially challenging. Recent successes show the benefit of open and transparent processes that allow sufficient time and include a concerted effort to assure that there is meaningful involvement of all stakeholders in the decision-making processes by following a flexible and adaptable strategy.

Ethical aspects, including considerations of fairness to current and future generations, are important for the development of disposal programmes.

Cultural, societal, and geographical similarities and differences have resulted in a variety of paths towards implementing national disposal solutions, but a common safety and security objective underlies all these paths.

通过公众及利益相关方建设性的参与，很多国家已经接受将地质处置作为高强度长寿期放射性废弃物长期处置的“参考”解决方案。

一些国家的地质处置工作的推进已经取得了相当的进展，但对于那些在推动过程中遭遇困难或阻碍的国家，地质处置依然被保留作为参考选项。

在国际原子能机构的“乏燃料安全管理及放射性废物安全管理联合公约”的安全标准规范，以及在国际辐射防护委员会的建议下，已经形成了共同框架，以指导国家对地质处置的安全监管和实施。

最先进的计划是把地质处置的推动建立在可以接纳持续学习，以及有意愿整合技术进步与社会需求的策略上。

场址的寻找及选择是关键步骤，而且充满政治与社会挑战性。目前成功的案例显示，有一个开放的、透明的程序，允许充足的时间来接纳协和一致的努力，并容许所有利益相关者均能有意义地参与决策，以便取得一个有弹性、可调整的策略是最有利的。

地质处置计划推动时道德方面的考虑相当重要，此应包括对当代以及未来世代的公平性考虑。文化、社会及地理上的差异性与相似性导致各国推动地质处置的方法与途径将会有所不同，但确保安全无害的共同目标应该是所有途径的根本。

### *Challenges and opportunities in practical implementation*

#### *实际实施过程面临的挑战与机会*

Regulators, implementers and policy makers have increasingly become aware that confidence by the technical community in the safety of geological disposal is not, by itself, enough to gain public confidence and acceptance.

There is consensus that a broadly accepted national strategy is required. This strategy should address not only the technical means to construct the facility but also a framework and roadmap allowing decision makers and the concerned public the time and means to understand and evaluate the basis for various proposed decisions and, ultimately, to gauge whether they have confidence in the level of protection that is being indicated by the implementing organisation and evaluated by the regulator through its independent review.

Reversibility and retrievability are considered by some countries as being important parts of the waste management strategy. Reversibility implies a disposal programme that is implemented in stages and that keeps the options and choices open at each stage, and provides the capacity to manage the repository with flexibility over time under specified conditions. Retrievability is the possibility to reverse the step of waste emplacement. There is general recognition that it is important to clarify the meaning and role of reversibility and retrievability for each country, and that provision of reversibility and retrievability must not jeopardise long-term safety.

Technical development and implementation of disposal projects demand decades to realize. The long implementation times afford opportunities for programme adaptation and enhancement. The related challenge is to maintain the support at both local and national levels, the necessary infrastructure, and human resources for knowledge preservation and transfer.

Phased decision-making has come to the fore as the preferred approach to deal with the long implementation times. Besides allowing for continued research and learning, phased decision-making provides the opportunity to build broad societal confidence in the concept and

to develop constructive relationships with the most affected regions. The related challenges are to maintain the processes and relationships, integrate advances, and ensure forward momentum.

管理者、执行者、政策制定者们已经越来越意识到：只有工程技术界对地质处置安全有信心，尚不足以获得公众的信心与接受。

一套被广泛接受的国家策略是大家的共识。策略中不应只阐明建造地质处置设施的技术问题，同时应提出体系架构与路线图，给决策者以及关心的大众提供足够的时间与方法来了解并评估各种方案的基础背景，以此来衡量公众对由设施建造者提供并由监管者完成独立审查的安全保障程度的信心。

确保“可逆性”和“可再取出性”在某些国家是放射性废弃物管理策略的重要部分。可逆性指地质处置计划将分阶段执行，每一阶段的选项与决定权保持开放，因此在特定的条件下，该处置计划仍可弹性调整；可再取出性则指可以恢复废物掩埋步骤的可能性。各国应进一步澄清“可逆性”与“可再取出性”的确切含义，并且需注意保留可逆性与可再取出性不可损害系统的长期安全性。

地质处置计划的执行及技术发展需要数十年来实现。冗长的执行期为调整方案的执行和建造技术的持续进步提供了有利机会，然而随之而来的挑战是：如何长期保持来自中央和地方的支持、如何维持必要的基础建设、如何确保因知识保存与传承所需要的人力资源。

由于地质处置计划执行期间太长，分阶段决策便成了相对重要也是可取的方法。分阶段决策除允许持续的研究和学习外，为在社会观念上建立信心提供了机会，同时也为发展与受影响区域的建设性关系提供了信心。但伴随而来的挑战是：如何保持这些发展进程和关系，以及如何整合各项工作的进展以及保持前进的动能。

### *Broad expectations on further development of geological disposal*

### *对地质处置未来发展的期望*

Collective experience and knowledge transfer have been helpful in facilitating development. International cooperation and sharing of research projects, experiences and lessons learnt should continue.

Delaying work on geological disposal – i.e. by adopting a “wait and see” strategy – would

require increasingly more demanding care for the waste and its storage facilities. Wastes stored at or near the surface will be more vulnerable over time to extreme natural events or terrorism than wastes disposed deep underground. Geological disposal thus provides an ethical basis for current generations to deal with the waste and it should be implemented.

经验的积累与知识的传承确实有助于计划的进展，因此国际合作、研究计划经验的分享以及经验交流应该继续进行。

延迟地质处置工作的进展——即采用“走着瞧”策略——无疑将会增加对废物本身以及贮存设施的照看需求。与深层地质处置比较，废物采用地表或近地表贮存，随着贮存时间拉长将更易受自然事件或恐怖分子的威胁。因此，地质处置提供了当代人们处理废物的道德依据，应该予以执行。

**GEOLOGICAL DISPOSAL PROVIDES A UNIQUE DURATION AND LEVEL OF PROTECTION FOR HUMANS AND THE ENVIRONMENT IN A MANNER THAT DOES NOT REQUIRE CONTINUED MONITORING, MAINTENANCE AND INSTITUTIONAL CONTROL. GEOLOGICAL DISPOSAL IS TECHNICALLY FEASIBLE AND WIDELY ADAPTABLE TO DIVERSE GEOLOGICAL SETTINGS. IT IS BEING DEVELOPED WORLDWIDE, WITH INCREASING INVOLVEMENT OF STAKEHOLDERS TO ASSURE THAT SOCIETAL REQUIREMENTS ARE TAKEN INTO ACCOUNT. MOVING FORWARD NOW WITH IMPLEMENTATION OF GEOLOGICAL DISPOSAL IS DESIRABLE FROM THE POINT OF VIEW OF BOTH ETHICS AND SAFETY. SUFFICIENT INFORMATION EXISTS NOW TO TAKE THE FIRST STEPS AND PUT A PLAN IN PLACE COMMENSURATE WITH THE CURRENT GENERATION'S RESPONSIBILITY.**

**地质处置为人类及环境提供了一个特定的时期和一定的保护水平，而且不需要我们持续对其开展监测、维护和制度上的监管。地质处置在技术上可行且能被广泛调整以适合不同的地质组成。通过增加利益相关者的参与来确保社会需求得以顾及，目前它在世界范围内得到广泛发展。从安全与道德的角度，地质处置计划当前是值得推动的。目前拥有的资讯已足够支持踏出地质处置的第一步，现在就请着手建立一套与这一代人责任相称的规划吧！**