A deep geological repository is from a radiological protection point of view a planned exposure situation from which, in fact, no public exposure is expected, although exposures in the far future cannot be ruled out. The repository’s purpose is to prevent any exposure to the radioactivity contained in waste. During the justification and optimisation process, the potential radiological exposures that might stem from a geological repository are evaluated and expressed in terms of “effective dose” or “risk” to a “reference individual”, that is, an individual with certain average physical characteristics, habits and state of health. Present-day habits and health status of populations, and the current level of health protection provided by radiological standards (as well as by other worker safety and/or public health standards) are taken as benchmarks. These terms and benchmarks are then used to evaluate whether the predicted performance of a given repository configuration provides sufficient protection from exposure.

The ICRP considers that the current benchmarks will continue to be meaningful up to and through the time when the repository is fully sealed, and a few centuries beyond. For individuals and populations who may live in the distant future, however, the ICRP prefers not to affirm that these terms and benchmarks will still have the same relevance as for today; people’s health and living standards and habits may change far beyond what we imagine. Thus, today’s calculations of effective dose and risk that may result in the long term are used not as predictions of potential health detriment, but as tools aiding to compare design options and to get reasonable assurance that a repository will meet, at the very least, the protective benchmarks of today.

Geological disposal of radioactive waste

The goal of geological disposal is to contain and isolate the waste in order to protect humans and the environment for periods that are comparable with geological time scales. Geological disposal is recognised by international organisations as especially suited for high level radioactive waste or spent fuel in which a high level of radioactivity is concentrated and which will remain significantly radioactive for many thousands of years. Geological disposal may also be used for other long-lived wastes, especially when there is a similar need for long-term protection. The ICRP has released new recommendations for the protection of humans and the environment for the case of the geological disposal of long-lived solid radioactive waste (ICRP Publication 122). These recommendations reflect the pledge that “individuals and populations in the future should be afforded at least the same level of protection as the current generation”. ICRP recommendations are typically transposed into national and international regulations and practices in radiological protection. Their implementation requires a management system integrating health, environmental, engineering, security, quality and economic elements. The application of the system of radiological protection to geological disposal takes into account the level of oversight or ‘watchful care’ that is present at any point in time.
principal from the operation of nuclear reactors. Many countries that operate nuclear reactors today are planning and moving toward the construction of geological repositories. Geological disposal may also be used for other long-lived wastes, especially when there is a similar need for long term protection.

The safety of a geological repository is first and foremost the responsibility of its designer and operator under the supervision of an independent regulatory body. Society at large is expected to play an influential role in choosing major options that affect safety, such as the location of the facility and how the facility is to be managed over time. Society can be expected to participate in the surveillance of the disposal facility.

Alongside proper licensed design and construction, and proper management practices by the repository operator, oversight contributes to protecting people and the environment. Oversight is the general term used by the ICRP for “watchful care” and refers to society “keeping an eye” on the technical repository system and the implementation of plans and decisions.

Oversight is accomplished through a variety of actions, such as direct supervision and control by the regulator and the society, monitoring of the pathways (water, air, soil…) through which radiological exposure potentials could occur, preservation of records and of societal memory of the presence of the facility, etc.

Designers of a repository have to take account of the fact that at any given point in time, the waste will be more, or less, accessible and therefore persons and institutions will have more, or less, opportunity to exercise direct control. The ICRP advises that decisions regarding the oversight of the facility should be discussed with the affected or interested publics.

The ICRP points out three periods of oversight:

1. **Direct oversight.** This is only possible when repository galleries are not yet sealed and the waste is accessible.
2. **Indirect oversight.** This complements direct oversight and gradually replaces the latter as galleries and the whole repository are sealed and the waste may only be monitored remotely.
3. **No oversight.** The loss of oversight is not planned, but it is recognised that it may happen at some time in the future after closure. Repository design should ensure that if oversight diminishes or disappears, this will not lessen the protective capability of the facility.

These foresight periods of oversight correspond to phases in the lifetime of the repository (Figure 1).

To ensure that the repository continues to play its protective role without relying on human actions or oversight, passive controls are built into the facility at the time of its design and licensing. These “built-in controls” rely on how the waste is conditioned and on the properties of canisters, engineered barriers and natural geological formation.

**Application of dose limits** – the total dose to any individual from regulated sources in planned exposure situations (...) should not exceed the appropriate limits recommended by the ICRP.

• This is a principle to follow when managing several sources of radiation at the same time. The dose limits recommended by ICRP for the protection of workers is 20 millisievert per year and 1 millisievert per year for the protection of the public. The values set for the dose and risk constraints in ICRP-122 are compatible with these limits.

In the process of justifying and optimizing any planned radiological exposure situation, operators and regulators are required to compare scenarios, assessing how much exposure could result under a given set of circumstances, and the health impact that this exposure could produce.