

NUCLEAR ENERGY AGENCY
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RWMC Regulators' Forum (RWMC-RF)

**CONTROL, OVERSIGHT AND RELATED TERMS IN THE INTERNATIONAL GUIDANCE ON
GEOLOGICAL DISPOSAL OF RADIOACTIVE WASTE – REVIEW OF DEFINITIONS AND USE**

This document presents the most complete analysis of the use of the words control, oversight, etc. as used in NEA, IAEA and ICRP literature connected to radioactive waste disposal. It reveals the many different ways the same word, “control”, has been used in international guidance and ambiguities than can arise, especially so for the post-closure phase of the repository. The newly introduced ICRP terminology, namely the use of the words “oversight” and “built-in controls”, represents a step forward in terminology.

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1. Background

The most recent (2013) ICRP guidance in the field of geological disposal of long-lived radioactive waste states that *“The crucial factor that influences the application of the (radiological) protection system over the different phases in the life time of a disposal facility is the level of oversight or ‘watchful care’ that is present. The level of oversight affects the capability to control the source, i.e. the waste and the repository, and to avoid or reduce potential exposures”* (ICRP-122). In particular, *“Oversight is a general term for ‘watchful care’ and refers to society ‘keeping an eye’ on the technical system and the actual implementation of plans and decisions. It includes regulatory supervision, in the form of control and inspection, preservation of societal records, and societal memory of the presence of the facility.”*

The ICRP document uses the term “oversight” to indicate activities, with or without regulatory force, that rely on the presence of man. It uses the expression “built-in controls” when referring to the intrinsic safety functions that the system’s components are designed to deliver. The document recognises that, to a varying degree over the lifetime of a repository, these two aspects are complementary to one another in providing for a safe performance. In previous international publications on waste disposal expressions such as “control” or “institutional control” and “passive control” were used.

The objective of the present document is to review terms or expressions that have been used so far in international guidance (IAEA, ICRP, and OECD/NEA) in connection with the concept of “control” – see Box 1. The Annex provides actual literature quotes. For each example a commentary is provided.

Box 1: Example of terms used in international guidance

In international publications on waste disposal expressions such as “control” or “institutional control” are used. The term “control” is often used with attributes such as :

Control of public exposures (ICRP-122)

Active Control and Active Institutional Control (IAEA glossary (2003, 2007), IAEA Safety Standards SSR-5, SSG-14 (2011), ICRP-122)

Regulatory Control (IAEA glossary 2003, 2007)

Passive Control (ICRP-122)

Passive Control and Passive institutional control (IAEA glossary (2003, 2007), SSR-5, SSG-14)

Built-in controls (ICRP-122)

Intrinsic, passive controls (NEA, R&R project)

Oversight was introduced in the OECD/NEA R&R project and taken up in the ICRP-122. Corresponding attributes are :

Direct oversight (ICRP-122)

Indirect oversight (ICRP-122)

Absence of oversight (ICRP-122)

Regulatory oversight (ICRP-122)

Indirect regulatory, administrative or societal oversight (ICRP-122)

Institutional oversight (NEA R&R project)

Active regulatory oversight (ICRP-122)

It must be noted that the present one is a review of terms as used in international guidance in the English language. National use and understanding of the terms analysed in this document may be different from the international use that is made of them. Because of this, the document should serve, in the first place, the purpose of information and basis for discussion, rather than that of harmonising vocabulary across national programmes.

Organisation of the document

Besides this introductory chapter, the document includes a second chapter on key findings and conclusions. Most of the document consists of actual quotes and commentaries that are given in the Annex.

2. Key findings

This document (see Annex) presents the most complete analysis of the use of the words control, oversight, etc. as used in NEA, IAEA and ICRP literature connected to radioactive waste disposal. It reveals the many different ways the same word, “control”, has been used in international guidance. Namely, the word “control” is used with many different nuances: as safety-determining and as subsidiary to safety; giving immediate results or not giving those results; as a form of management of the waste and its repository and as a form of externally imposed verifications; carried out only by the nuclear regulators or carried out by other institutions as well.

It is of the essence in regulatory guidance to specify **who** (exactly) should be doing **what** (exactly), while the **means** that may or may not be employed are usually of secondary importance. Therefore, the usefulness of terminology should be considered – amongst others – under the aspect of being able or unable to naturally distinguish amongst these three aspects. It turns out that, in international texts, all three aspects (and more) are associated with the current use of the word control. Control can thus be identified with:

- who or what is the “controller¹”;
- the function that is attributed to control; and
- the means that support “the controller” in exercising that function.

The concept of “oversight” as more recently developed by the ICRP is less ambiguous than “control”. It designates a function that is always carried out by people, which can be carried out at different degrees by various actors at different periods of time. Oversight is described, and can be seen, as implementing forms of control, which can result in immediate corrective actions, with or without regulatory force, and also as implementing forms of memory keeping. Regulatory inspections during the operational phase would serve the purpose of – and are part of – oversight. Maintaining the repository archives would also serve the purpose of oversight. Oversight is connected to the concept of continued societal responsibility.

Because oversight is only by man, a term is needed for functions carried out by the system components that also support safety. These functions are the “built-in controls” mentioned by the ICRP-122. For instance, the components that constitute a nuclear waste repository act – together or independently from one another – to control the access of groundwater and corrodants, the pH of the near field, the release of radionuclides, etc. The complementarity of the terms oversight and “built-in controls” appears to do away with the ambiguity connected to the word “control”.

In order to try to resolve the ambiguities of the word “control” as applied to a situation where “control” is in fact progressively removed from the presence of a man, several composite expressions have been

¹ Controller = a person or things that controls (Concise Oxford English Dictionary, 1990 Edition)

created in the literature, such as “institutional control”, “active/passive control”, “passive institutional controls”, etc., with additional explanatory texts to explain whether or not one is in a safety context. Altogether, these expressions do not clarify understanding. As shown in the Annex, it turns out that the IAEA documentation recognises that built-in passive safety “features” exist, but the connection to control is not made. The transition from control by man to control by the passive safety features is not made explicit, nor is there mention that for a certain period of time these two forms of control will overlap. Control, in the IAEA sense, is always carried out by people and implies knowledge. It is only in recent NEA and ICRP documents that a clear recognition is found that “control” will be a shared function between the human controller and the various barriers that carry out the built-in controls.

Recently, the NEA RK&M project has been confronted with the issue of terminology in general. Over the three-years of the project, a glossary has been developed specifically to address post-operational issues by employing terminology that is internally consistent and unambiguous. The latest version of the glossary², which is continuously developed, is available for download on the RK&M Project’s website³. A strategic article on terminology has also been provided⁴. The present document is consistent with the RK&M terminology findings.

It is concluded that:

- There is a clear need to explain through unambiguous terminology, in regulations as well as in non-regulatory texts, that what can be accomplished in terms of control/oversight varies throughout the repository life-phases.
- The current terminology in the international texts based on the word “control” is ambiguous, especially so for the post-closure phase of the repository. The newly introduced ICRP terminology, namely the use of the words “oversight” and “built-in controls”, by and large resolves the ambiguity.

² OECD NEA (2014) “Glossary of Terms. Preservation of Record, Knowledge and Memory across Generations.”, NEA/RWM(2011)14/REV4.

³ <http://www.oecd-nea.org/rwm/rkm/>

⁴ OECD NEA (2014) “Articles about strategic aspects of RK&M preservation”, NEA/RWM(2014)5.

ANNEX: DEFINITIONS FROM BIBLIOGRAPHICAL SOURCES AND RELEVANT COMMENTARIES

1. Dictionaries online

1.1. Cambridge Dictionaries online

Control

- *“to control” means “to order, limit, or rule something, or someone's actions or behaviour”.*

Examples:

- If you can't control your dog, put it on a lead!
- You're going to have to learn to control your temper.
- The temperature is controlled by a thermostat.
- The laws controlling drugs are very strict in this country.
- The government is trying to control spending.

Oversight

- *a mistake made because of a failure to notice something.*
Example: They claim it was only an oversight.

- *responsibility for a job or activity and for making sure it is being done correctly.*
Example: Who has oversight of genetic testing?

1.2. The Concise Oxford Dictionary

Control as a noun

- *the power of directing, command;*
- *The power of restraining, esp. self-restraint;*
 - *a means of restraint; a check;*
 - *(usually in plural) a means of regulating price etc.*
 - *(usually in plural) switches and other devices by which a machine, esp. an aircraft or vehicle is controlled (also attribute: control panel, control room)*
 - *a place where something is controlled or verified*
 - *a person or group that controls something*
 - *a standard of comparison for checking the results of a survey or experiment”*

Control as a transitive verb

- *To have control or command of; dominate*
- *to exert control over; regulate;*
- *to hold in check; restrain*
- *to serve as control to*
- *to check, verify”*

Examples:

- Controlling interest
- Control rod
- Control tower
- In Control
- Out of control
- Under control
- Controllable (adjective)
- Controllability
- Controllably

The term “control” suggests dominance, influence, power, or full knowledge of a specific situation and ability to react with immediate results. Control can be carried out by individuals, institutions and inanimate objects. The word “control” can be used both as a verb and as a noun.

The term “control”, as a noun, can carry several fundamentally different meanings (cf. list of meanings in Oxford Dictionary), at least two (possibly three) of which are in frequent use in international guidance on geological disposal of radioactive waste: the function of controlling, and the means for applying the function of controlling. The details of these differences and their possible significance for international guidance are expounded in Box 2. It is also interesting to note the appositional use of the word “control”, as in “control switch”, “control key”, “remote control”, where the distinction between the function and the means of control is blurred.

Box 2: Who or what is involved, when something is being controlled

- When something is being controlled, the term “control”, as a noun, may be used to denote any of the following aspects of the situation:
 - The function of controlling (cf. Oxford Dictionary meanings no. 1. and 2.)
 - The means that the controller employs (Oxf. Dic. no. 3./4./(5.))
 - The controller, i.e. the person or thing that exercises control (Oxf. Dic. no 6.b/(5.))
- To use the term “control” with meanings (a and b) – but not with meaning (c) – is endorsed by the IAEA Safety Glossary (2007, see below Sect. 2.2). However all three meanings are apparently in use in (inter)national guidance documents on radioactive waste disposal (see Sect. 2.2 to 2.5).
- Apart from the semantic difficulty to distinguish between (a), (b) and (c), there is also a considerable subjective element in the distinction between (b) and (c): In the sentence “The temperature is controlled by a thermostat”, the thermostat is the controller. The same situation could be expressed as “The temperature is controlled by means of a thermostat”. Now the thermostat is the means to exercise control, and the person or thing that exercises (or is in charge of) the control remains unspecified (could be, e.g., a person in a modern hotel room, or a programmable mechanical controller). In both cases alike, the control function could be described as “keeping the temperature in a specified range”. Note that the subjective difficulty in distinguishing between (b) and (c) can be blurred by the semantic ambiguity, since the expression in the first sentence “by a thermostat” may in common language be decoded into “by means of ...”.

In this paper we use the term “control” (unless it is a quote) when we mean the function of control, and say “means of control” and “controller” otherwise.

Oversight

- *A failure to notice something*
- *An inadvertent mistake*
- *Supervision*

Oversight can have two sets of meaning in English. In our case the meanings bearing on “responsibility”, “supervision” apply. Oversight is a function; it is never an object, in contrast to e.g. a “control switch”. Oversight is always carried out by people. Unlike “control”, “oversight” can only be used as a noun in English and not as a verb. The verb that indicates the exercise of oversight is “to oversee”. “Oversight” in contrast to “control” eliminates many of the ambiguities related to the use of verb versus noun, or the possible confusion between the function and the means of that function.

Passive

- *Suffering action; acted upon;*
- *Offering no opposition; submissive;*
- *Not active; inert*
- *(of a metal) abnormally unreactive.*
- *(Grammar) designating the voice in which the subject undergoes the action of the verb*
- *(of a debt) incurring no interest payment”*

We note that these meanings are different from “passive” as typically intended in the nuclear field (see next section), namely suggesting independence from the presence of an operator (passive safety) by relying only on built-in components and mechanisms during an accident.

2. IAEA

2.1. Control

IAEA Safety Glossary (2007): *“The function or power or (usually as controls) means of directing, regulating or restraining.”*

Comment in the IAEA Safety Glossary: *“[...] control in safety related contexts [...] typically implies not only checking or monitoring something but also ensuring that corrective or enforcement measures are taken if the results of the checking or monitoring indicate such a need.”*

It may be noted here that “control” can carry the meanings of both the function and the means of “directing, regulating, or restraining” (cf. Box 2). Equally notable is the strong connection between “safety” and the ability to effect any changes to a situation. Namely, through control, corrective actions can be taken. Control, in this sense, is carried out by people and implies knowledge, ability to intervene and immediate results.

2.2. Regulatory control

IAEA Safety Glossary (2007)⁵: *“Any form of control or regulation applied to facilities or activities by a regulatory body for reasons relating to radiation protection or to the safety or security of radioactive sources”*

“Control” here requires the presence of a regulatory body to be exercised and it is in connection with “facilities or activities”.

Also, “regulation applied to a facilities or activities” appears to refer to guidance and rules, and is presented here as a form of control. We would comment that, in fact, such regulation is the basis or means for applying control.

2.3. Institutional control, active and passive

IAEA Safety Glossary (2007)⁶: *“Control of a radioactive waste site by an authority or institution designated under the laws of a State. This control may be active (monitoring, surveillance, remedial work) or passive (land use control) and may be a factor in the design of a nuclear facility (e.g. near surface repository).”*

Vis-à-vis the previous quotes from the same glossary, this quote suggests that “control” in connection with a “site” – as distinct from “facilities or activities” – may be carried out by others than the safety authority and may be “passive”. The active part is carried out by people. The passive part also seems to be carried out by people as “land use control” is a human activity and as the connection to near-surface repositories also suggests.

The wording "control of [something] by an [...] institution" clarifies two important things: Firstly, it states that "control" in this IAEA definition of "institutional control" refers to the function of control – not to a means of control as was one of the possibilities in the IAEA definition of "control" itself. Secondly, it states that the institution is the controller – not the provider of a means of control. As a consequence, using "institutional control" – be it active or passive – to denote a means of control or to denote a function of control exercised by anybody else than authorities or institutions, would not be in accordance with the definition in the IAEA Safety Glossary (2007).

Even though in the definition of “institutional control”, the partition into the disjunctive sets “active institutional control” and “passive institutional control” is made and seems to be important, the distinguishing feature, i.e., the definition for “active” and “passive” in this context, is missing.⁷ Since institutional control is a special form of control, it is interesting to note that in the definition of “control” in the same document, no partition into “active” and “passive” is made. It is also important to note that only examples but no definitions are provided for “active institutional control” and “passive institutional control”, and that neither definitions nor examples are provided for “active control” and “passive control” even though the latter two expressions are used frequently in international guidance (also by IAEA).⁸

⁵ An almost identical definition is given in the IAEA RWM Glossary (2003)

⁶ An almost identical definition is already given in the IAEA RWM Glossary (2003).

⁷ Only if the examples provided (monitoring, surveillance, remedial work on the one hand – land use control on the other hand) were to be understood as conclusive enumerations, could these lists be regarded as complete definitions. However, the lists are, in all evidence, to be interpreted as non-exhaustive lists of examples.

⁸ It remains unclear whether "active control" and "passive control" are to be understood as abbreviated forms of the IAEA glossary terms "active institutional control" and "passive institutional control". Documents using

In order to get as close as possible to the definition of “active” and “passive” in this context, we invoke the IAEA definitions of “active” and “passive component” – being aware that “control” as defined by IAEA refers to a function or a means, not exactly to a component:

Active component: *“A component whose functioning depends on an external input such as actuation, mechanical movement or supply of power, i.e. any component that is not a passive component.”*

Examples of active components are pumps, fans, relays and transistors. It is emphasised that this definition is necessarily general in nature, as is the corresponding definition of passive component. Certain components, such as rupture discs, check valves, safety valves, injectors and some solid state electronic devices, have characteristics that require special consideration before designation as an active or passive component.

Contrasting term: passive component.”

Passive component: *“A component whose functioning does not depend on an external input such as actuation, mechanical movement or supply of power. A passive component has no moving part, and, for example, only experiences a change in pressure, in temperature or in fluid flow in performing its functions.*

In addition, certain components that function with very high reliability based on irreversible action or change may be assigned to this category.

Examples of passive components are heat exchangers, pipes, vessels, electrical cables and structures. It is emphasized that this definition is necessarily general in nature, as is the corresponding definition of active component. Certain components, such as rupture discs, check valves, safety valves, injectors and some solid state electronic devices, have characteristics which require special consideration before designation as an active or passive component.

Any component that is not a passive component is an active component.”

An active/passive component in the nuclear field is therefore related to the presence of an external input mechanism and there is no direct connection with the presence or absence of man.

On the contrary, as recognized in 1.2.4, passive nuclear safety is closely related to the level of man intervention in nuclear power plants. Safety systems are used to maintain control of the plant without operator intervention if it goes outside normal conditions in case of anticipated operational occurrences or accidents, while the control systems are used to operate the plant under normal conditions. Sometimes a system combines both features. The difference between passive and inherent safety is that passive safety refers to safety system components, whereas inherent safety refers to control system process regardless of the presence or absence of safety specific subsystems.

By extension, the expression “passive safety” was introduced in long-term radioactive waste management in order to outline that the safety features put in place operate without the presence of man. This led to the expression “passive controls” introduced in ICRP-122 (see section 4) when the control by the system

"active/passive control" generally do not specify this, while sometimes referring to the IAEA Safety Glossary (2007), which, however, does not specify this, either. Since "control", according to the IAEA Safety Glossary (2007), is not an abbreviation for of "institutional control", it must be assumed that "active/passive controls" refer to the definition of "control" and not to that of "institutional control", leaving then the meaning of “active” vs. “passive” in “active/passive control” completely unspecified.

components (canisters, engineered barriers and natural geological formation) of the repository becomes predominant over the control by man.

IAEA SSG-14 (2011): *“Monitoring or institutional controls is not to be relied on for the safety of the facility after closure.”*

Comment in the IAEA Safety Glossary: *“The term institutional control is more general than regulatory control (i.e. regulatory control may be thought of as a special form of institutional control). In particular, institutional control measures may be passive, they may be imposed for reasons not related to protection or safety (although they may nevertheless have some impact on protection and safety), they may be applied by organisations that do not meet the definition of a regulatory body, and they may apply in situations which do not fall within the scope of facilities and activities. As a result, some form of institutional control may be considered more likely to endure further into the future than regulatory control.”*

In the context of geological disposal facilities, it is suggested, institutional control measures may be “passive” and, unlike the previous quote for “control”, the control in “institutional control” is no longer connected only to safety.

IAEA SSG-14 (2011): *“Geological disposal facilities are designed to be passively safe in the post-closure period (i.e. not requiring intervention to ensure safety) and the long term safety of a disposal facility for radioactive waste is not to be dependent on active institutional control.”*

“Passive institutional controls should be established to prevent or reduce the likelihood of inadvertent human actions that could interfere with the waste or degrade the safety features of the geological disposal facility. Institutional controls may include the construction of durable markers, the posting of facility records in national and international archives accessible to future populations and the transfer of responsibility for the facility to a successor organisation.”

“Passive institutional controls” are identified here as means to address safety threats due to inadvertent human actions. The second sentence is ambiguous since the means and the actions to establish the means are mixed up. The “controls” that are suggested literally - the construction, the posting and the transfer - are actions that are very different from control (as an action/function).

We may note that the markers, the archives and the responsibility of a successor organisation do not constitute controls by themselves but are means to allow future control by people. Control would be transferred into the hands of those who take advantage of those means. Actually, the above quote also gives the impression that there will always exist institutions that will be using these means (the archives etc.), which can be misleading.

IAEA SSR-5 (2011): *“An appropriate level of surveillance and control shall be applied to protect and preserve the passive safety features, [...] so that they can fulfil the functions that they are assigned in the safety case for safety after closure. [...] The long term safety of a disposal facility for radioactive waste is required not to be dependent on active institutional control.”*

This quote recognises that “passive safety features” exist, that they are in charge for providing safety after closure, and that they must be robust enough not to depend on human actions (active institutional control). However, the connection is not made between these features and control carried out by these safety features. Control, in the IAEA sense, implies knowledge and is always carried out by people.

“The risk of intrusion into a disposal facility for radioactive waste may be reduced over a longer timescale than that foreseen for active controls by the use of passive controls, such as the preservation of information by the use of markers and archives, including international archives.”

The example of “passive controls” mentioned here, “preservation of information” (by the use of markers and archives), is – again – a means to inform control and the markers and archives are means to implement the function.

“Geological disposal facilities have not to be dependent on long term institutional control after closure as a safety measure”

“The licence will be terminated after the period of active institutional control, when all the necessary technical, legal and financial requirements have been fulfilled.”

“While the facility remains licensed, the operator has to provide institutional controls. It is envisaged that the responsibility for whatever passive measures for institutional control are necessary following termination of the licence will have to revert to the government at some level.”

In these quotes the operator is one provider of “institutional control” but only through the licensed period. After termination of the licence, SSR-5 suggests that the period of active institutional control (implying human presence and implication) will be terminated and that passive measures will be implemented. The government is identified as responsible for the passive institutional control, i.e. if this “control” were a function, the government would be the controller. However, as there is no mention of any activity the government has to undertake, passive institutional control seems not to be a control function and not to imply human actions. One important question to this effect is: May a decision be taken to stop human action? The ICRP suggests that the repository will continue to be a functioning nuclear facility at all times, and that the end of human implication, that is the end of “oversight” should not be planned for, only the (accidental) loss of oversight should be planned for.

In the last quote, the “passive measures for institutional control” in the hands of the government may refer to “passive institutional control”, as given in the IAEA glossary (land use control, which is a people's activity as explained above). More likely, they refer to the means of passive institutional control named in SSG-14 (archives, markers) or to the “passive control” named in SSR-5 itself, “preservation of information”. Either way, the noted measures finally taken to exercise the control are rather active than passive, and possibly taken by somebody who is not the government. The expression “passive measures for institutional control” is thus confusing.

3. R&R PROJECT OF THE NEA

3.1. Control: active, passive, intrinsic

Final Report of the NEA R&R Project (2007-2011): *“Control can take place through measures that do not necessarily rely on man. For instance, the barriers that constitute a nuclear waste repository do exercise some types of control functions long after closure of the repository: they control the access of groundwater, the temperature of the near field, the release of radionuclides, etc. These are forms of intrinsic, passive controls.”*

“Active controls require instead the presence of a regulator or other oversight organisation, e.g., in the form of inspections, verification of records, verification of quality assurance procedure, verification of safeguards, etc.”

These quotes attempt to separate the actions performed by man or by components of the system. The former are qualified as “active controls”; the latter as “intrinsic, passive controls”

3.2. Oversight: direct, active, indirect

“Oversight is the more general term that refers to society “keeping an eye” on the technical system and the actual implementation of plans and decisions. Monitoring, if used by regulators to check whether regulations are being met, can be seen as an active control measure; if it used by society to check that the environmental conditions are not degrading, it is an active control measure but under an oversight rather than a regulatory regime. In this sense we may refer to it as an “active oversight” measure.”

The quote suggests that an “oversight regime” is different from a “regulatory regime”. Prior use of terminology referring to “oversight” and “oversight regime” should be looked at.

“For the time period following closure, when the presence or the role of the regulator is not assured, we consistently use the more general term of “Institutional Oversight” rather than of “Institutional control”, reflecting the fact that the regulation-enforcing aspects after closure may be weaker than in the earlier period (Fig. 4 in section 4.1 gives an indication of the very long-term time scales in question). This institutional oversight may also be considered to be indirect oversight, as compared to the direct oversight before closure, as there is no longer access to the underground facilities.”

Oversight is always performed by man. Oversight is never passive. This quote attempts to distinguish actions performed by society at large, from actions performed by safety regulators and other institutions. The same means of oversight, e.g., monitoring, may be used by one or the other, but with different aims. It suggests that “control” is the form of oversight that is exercised by safety regulators.

3.3. Regulatory, institutional control

“Regulatory Control (authorisations): As described in an NEA study of regulation of waste management, in a broad sense the regulatory control process for radioactive waste management includes not only the process of formal control by a nuclear safety and/or environmental safety regulator, but also the wider processes related to political and societal decision making regarding waste management strategies and projects.”

This quote makes reference to the observation, by the NEA Regulators’ Forum⁹, that technical regulation is part of a broader regulatory system, and that it is this broader regulatory system that determines, in the end, what is “safety” and which decisions should be made. In this sense “regulatory control” is substantially different from the IAEA’s definition of regulatory control.

“Institutional control consists of those actions, mechanisms and/or arrangements implemented in order to maintain control or knowledge of a waste management site after project closure and to inform current and future generations of hazards and risks.”

⁹ OECD NEA (2012), “The Evolving Role and Image of the Regulator in Radioactive Waste Management, Trends over two decades”, NEA n° 7083.

“Eventually, it may be necessary to replace, modify, or terminate the controls. Procedures should be established for modifying or terminating institutional controls when warranted.”

Institutional control is limited here to the post-closure period, which is substantially different from the IAEA definition. Institutional control may at one point be ended intentionally or be modified, possibly to give rise to other forms of follow-up on the disposal facility. They would then still be part of oversight.

4. ICRP

4.1. Control

ICRP-122: *“(43) The Commission views the potential exposures to humans and the environment associated with the expected evolution of the geological disposal of long lived solid radioactive as a planned exposure situation. The management of the source is deliberate and clearly planned and there is obligation to provide controls to ensure that during the operation and post-operational phases of a geological disposal facility an optimized protection is ensured. However, particular circumstances, which may not be part of the normally expected and planned activities, may rise.”*

ICRP-122: *“As stated in previous publications on radioactive waste management (ICRP, 1997b,1998), the control of public exposure through a process of constrained optimisation will obviate the direct use of the public exposure dose limits in the control of radioactive waste disposal (ICRP, 1997b, Para. 48).”*

Control is in the first place control of public exposures. Control, in this sense, is more in the meaning of reducing, limiting exposure and is the result of a process: the process of constrained optimization.

4.2. Control, regulatory supervision and oversight

ICRP-122: *“The level of oversight affects the capability to control the source, i.e. the waste and the repository, and to avoid or reduce potential exposures.”*

Oversight is used here as a concept larger than control. The ability to control (by man) is limited by the level of oversight that is present. Control is used as a synonym of safe management, of the waste and its repository.

ICRP-122 glossary: *“Oversight is a general term for ‘watchful care’ and refers to society ‘keeping an eye’ on the technical system and the actual implementation of plans and decisions. It includes regulatory supervision, in the form of control and inspection, preservation of societal records, and societal memory of the presence of the facility.*

Three time periods are considered for oversight:

- *Direct oversight refers to active control measures during the operational phase of the facility e.g. inspections and monitoring.*
- *Indirect oversight refers to measures that are used once the facility is closed and there is no longer access to the underground facilities e.g. a period of continued regulatory control, preservation of land use records, monitoring by society to check that the environmental conditions are not degrading.*

- *No oversight refers to situations when the memory of the presence of the disposal facility is lost and society no longer keeps a watchful eye on the facility.*”

Oversight is identified with continued responsibility for keeping an eye on the facility. It is outperformed by man and it may be carried out both through activities of the safety regulator and through societal engagement. Oversight may one day cease. Societal engagement may last longer than regulatory activities.

The various types of oversight possibilities affect the ability (by man) to control (manage) the source. By definition, no management is possible in the absence of oversight.

4.3. Passive, built-in controls, passive safety

(ICRP-122 main text): *“(27) During the operational phase, it is expected that direct oversight of the facility is performed consistent with the oversight performed at other nuclear facilities that handle similar radioactive materials (e.g. regulatory inspections). Following closure of the facility (post-operational phase), it is expected that indirect oversight includes the monitoring of the performances of the repository and potential pathways for exposure, the preservation of records of the presence of the facility and the verification of land-use restrictions. However, the continuation of indirect oversight during the post operational phase becomes more uncertain at later times (e.g. hundreds of years), and it may be assumed that at some point in time, memory could be lost and there is no further indirect oversight. This is one reason why geological disposal facilities are developed and designed not to rely on oversight in the distant future (i.e. passive safety), although the aim is not to lose the memory of the site.”*

ICRP-122: *“In the periods of indirect or no oversight, once the facility is sealed, protection relies on the passive controls built-into the facility at the time of its design, licensing and operation.”*

ICRP-122: *“At some point in the distant future, the memory of the presence of the disposal facility may be lost. The choice of location of the geological disposal facility and its technical design will constitute the remaining ‘built-in control’ against inadvertent intrusion into the facility”.*

Different forms of oversight are possible depending on the accessibility of the waste. Oversight should never cease, but memory may be lost some time in the future. Along with oversight activities by man, “passive” built-in controls will also be built and will be operational in the facility. These “built-in controls” are what is left when oversight no longer exists; they are complementary forms of controls during the period of lack of access to the waste. These ‘built-in controls’ rely on how the waste is conditioned and on the properties of canisters, engineered barriers and natural geological formation and how they function in relation to one another (see also the ICRP quote in section 5).

In these quotes control is used with the attributes “passive, built-in”. The aim is to distinguish between “control” by man and “control” by the system components themselves.

The connection between oversight and built-in controls or built-in safety provisions is described in Fig. 1.

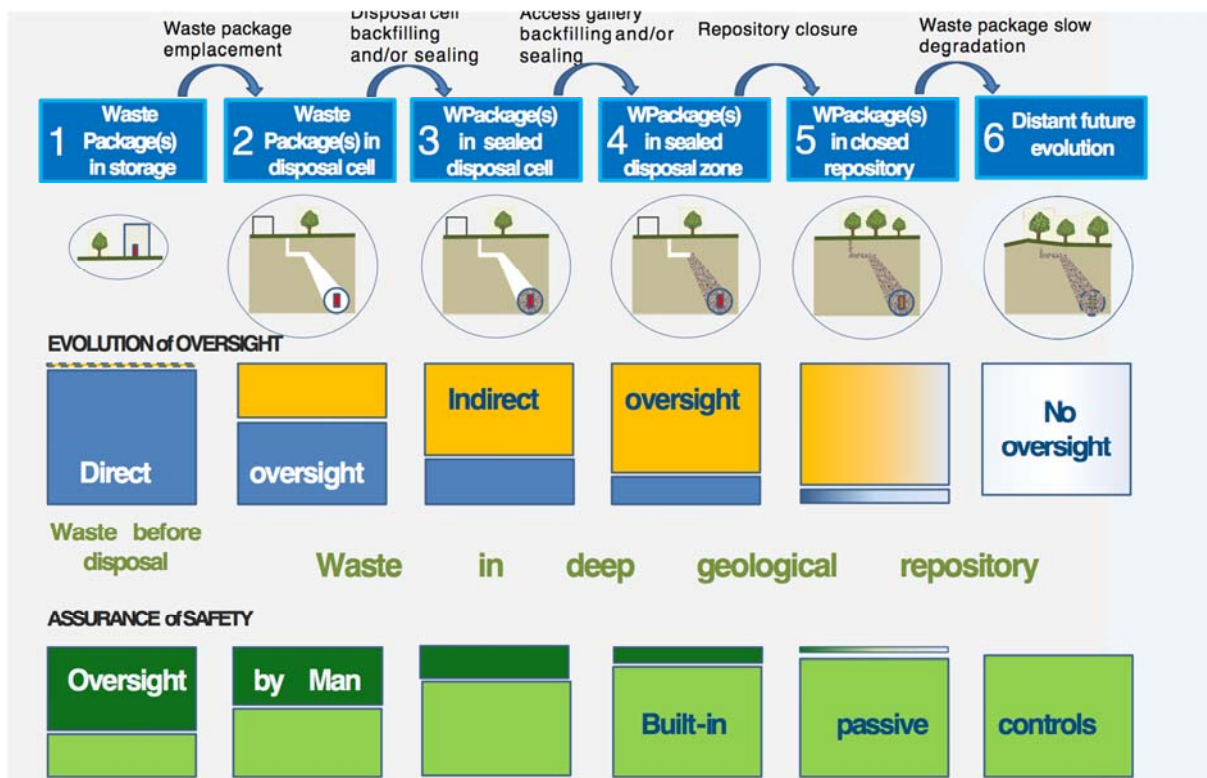


Fig. 1. Evolution of oversight and means of assuring of safety over the repository lifetime according to ICRP. The transition to a no-oversight period is hypothetical, but it cannot be excluded, and a repository is specifically designed and licensed so that its safety does not rely on the presence of man. This is why built-in, “passive” controls gradually become predominant in the assurance of facility safety .

5. ICRP/NEA FLYER

Oversight

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 potentially 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:

- Direct oversight. This is only possible when repository galleries are not yet sealed and the waste is accessible.
- 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.
- 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 foreseen periods of oversight correspond to phases in the lifetime of the repository as illustrated below in Figure 2.

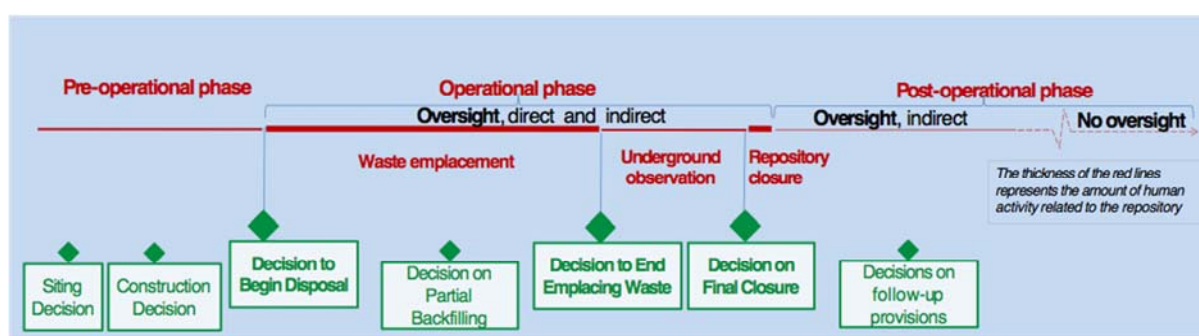


Fig. 2. Repository life phases and periods of oversight. The actual duration of each life phase will vary with each national disposal project.

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.

This long quote clarifies the ICRP-122 concepts of oversight, built-in, “passive” control, and direct vs. indirect oversight. (see also Fig 1)

6. KEY OBSERVATIONS

The above quotes allow several observations to be made:

1. There is general recognition in the IAEA glossary of 2007 that bodies other than the technical regulator, including political bodies, local communities, etc. play a role in decision making. Indeed, there exist also other regulators than the nuclear regulator, e.g., on matters related to the environment and spatial planning. Since 2007, a clear shift in terminology towards accounting for other roles than that of the nuclear technical regulator has come about. The use of the expression “institutional control” instead of “regulatory control”, for instance, captures this trend in the case of control relying on man in the post-closure phase of a radioactive waste disposal facility.
2. There is a clear need to explain through terminology that what can be accomplished in terms of “control” varies with the operational life-phases of the repository. Terminology such as regulatory control, societal control, passive controls, etc. has been introduced to serve that need.

3. In the term “control” there is the idea of dominating, limiting and ruling something. Through control corrective actions can be taken. As quoted in the IAEA glossary “control in a safety related context implies that ... corrective or enforcement actions are taken ... if needed”. However, in other contexts (e. g. institutional control of geological disposal facilities of radioactive waste), control is not seen as safety dominated.
4. There is confusion between “control” as an action that man carries out and the means (regulations, archives, markers, etc.) that man can direct to carry out its control actions. The latter are termed “passive (institutional) controls”, but they are not control in the sense of limiting or ruling. The expression “passive institutional control” is therefore misleading since it covers controls that are not institutional in the sense that they are not ruled by institutions and they are not “passive controls” in the sense that they are not controls performed by passive (or other) safety features.
5. The IAEA documentation recognises that passive safety “features” exist, but the connection to control is not made. The transition from control by man to control by the passive safety features is not made explicit nor there is mention that for a certain period of time these two forms of control will overlap.
6. Control, in the IAEA sense, is always carried out by people and implies knowledge. It is only in the recent NEA and ICRP documents that clear recognition is given to the role of the “built-in controls” and to the complementarity between built-in controls and oversight.

We conclude that the current terminology is not fully consistent across or within international organisations.

The quotes presented above show that the word “control” is used with many different nuances: as safety-determining and as subsidiary to safety; giving immediate results or not giving those results; as a form of management of the waste and its repository and as a form of externally imposed verifications; carried out only by the nuclear regulators or carried out by other institutions as well.

An important issue with the use of the word “control” is that confusion is often made between the means through which control is exercised and the function or action of control.

“Control” may be carried out both by people and inanimate objects. Yet, because control is strongly connected to the implementation of corrective actions and because the latter is often seen as the purview of man, the control that is exercised by the system itself through its own intrinsic features is masked.

The commonly-used term “passive control” can be misleading. Control is an action and is therefore an active function. “Passive” must then either mean “independently of man”, which is a distinct concept, or “passive” refers not to the function of control but to a means of control, without reference to who exercises the control and which (control) function was actually envisaged. Archives, for instance, can hardly be “passive controls” since they likely require the presence of man (if not to be maintained, then at least for their contents to be interpreted). They could be a means to support control by people but it is unclear to which control function they are connected. Certainly archives don’t exercise control themselves.

The term “oversight” introduced more recently in the literature is less ambiguous than “control”. It designates a function that is always carried out by people and is connected to the concept of responsibility, which can be attributed to different degrees and to various actors at different periods in time. Oversight can be seen as implementing forms of control that can result in immediate corrective actions, with or without regulatory force, and also as implementing forms of memory keeping. Archives, for instance, would serve the purpose of oversight. At the same time, regulatory inspections during the operational phase would also serve the purpose of oversight.

Because oversight is only by man, a term is needed for functions carried out by the system components that also support safety. These functions are the “built-in controls” mentioned by the ICRP-122. For instance, the components that constitute a nuclear waste repository act – together or independently from one another – to control the access of groundwater and corrodants, the pH of the near field, the release of radionuclides, etc. The complementarity of the terms oversight and “in-built controls” appears to do away with the ambiguity identified above in the terminology of “active” vs “passive” controls.