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Review of project permits under the London Protocol – An assessment of the proposed P18-4 CO₂ storage site

Tom Mikunda^{a*} and Tim Dixon^b

a TNO, Princetonlaan 6, 3584 CB Utrecht, The Netherlands

b IEA Greenhouse Gas R&D Programme, Pure Offices, Cheltenham Office Park, Hatherley Lane, Cheltenham, GLOS, GL51 6SH, United Kingdom

Abstract

The London Protocol (1996) is a global agreement to promote the protection of the marine environment by prohibiting the dumping of wastes and other matter into the sea. Under the Protocol all dumping is prohibited, with the exception of a limited number of selected wastes on the so-called "reverse list", which can be considered for dumping. In 2007, an amendment entered into force which permitted CO₂ streams to be considered for dumping under the London Protocol. The amendment was shortly followed up with a set of "Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations", developed to support the National Authorities of Contracting Parties in evaluating permit applications for CO₂ disposal activities in their marine territories. The objective of this report is to assess to what extent the proposed P18-4 CO₂ geological storage site in the Dutch North Sea, originally part of the ROAD CCS Project, complies with the aforementioned guidelines, and therefore the 1996 London Protocol itself. The assessment has been achieved through a simple, but systematic, cross check of the requirements of the guideline against the contents of the application material provided by the operator to the National Authority. This assessment finds that the material submitted to the National Authority is broadly sufficient to allow an evaluation of the planned CO₂ storage activities in a manner consistent with the provisions of the 1996 London Protocol. The assessment indicates overall technical compliance with the CO₂ Specific Guidelines, with no information sufficiently absent to indicate clear non-compliance. There are, however, eight areas from within the application material whereby the information or justification is partially sufficient, but may require further clarification, and one area of non-compliance from within the permit conditions, which is the responsibility of the National Authority. A number of recommendations are provided.

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* Corresponding author. Tel.: +31 646966123
E-mail address: tom.mikunda@tno.nl

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1. Introduction

1.1. The London Protocol

The "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972", the "London Convention" for short, is one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.

In 1996, the "London Protocol" (LP) was agreed to further modernize the Convention and, eventually, replace it. Under the Protocol all dumping is prohibited, except for possibly acceptable wastes on the so-called "reverse list", listed in Annex I of the Protocol. The Protocol entered into force on 24 March 2006, and there are currently 46 Parties to the Protocol. The Netherlands is a Party to the London Protocol.

1.2. CO₂ sequestration in the London Protocol

In 2006, in recognition of the potential damage that human induced climate change could have on the marine environment and the emergence of carbon capture and storage (CCS) as a promising mitigation option, the LP was amended to add CO₂ onto the list of possible acceptable wastes which could be "dumped". In fact, it was agreed that "Carbon dioxide streams from carbon dioxide capture processes for sequestration" could be considered for dumping (Annex 1, Para 1.8), only if:

1. disposal is into a sub-seabed geological formation; and
2. they consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture and sequestration processes used; and
3. no wastes or other matter are added for the purpose of disposing of those wastes or other matter.

The amendment entered into force on 10 February 2007 for all Contracting Parties to the Protocol.

The consideration of dumping material on the so-called "reverse list", must adhere to the general requirements of Annex II of the LP, which covers, inter alia, a waste prevention audit, consideration of waste management options, characterisation of the waste, dumpsite selection, assessment of potential effects, monitoring, permit and permit conditions.

Given the specificity of CO₂ sequestration, a CO₂ Working Group was established by the London Protocol Scientific Group to consider and produce guidelines for the assessment of CO₂ sequestration in sub-seabed geological formations. In November 2007, the "Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations" were adopted by the Parties to the LP [1]. The Specific Guidelines, provide additional guidance for CO₂ sequestration projects to comply with the requirements of Annex II.

In addition to the Specific Guidelines, the "Risk Assessment and Management Framework for CO₂ Sequestration in Sub-Seabed Geological Structures" (RAMF) was also adopted in October 2006, which aims to provide generic guidance to Parties on the characterisation and management of risks of CO₂ sequestration to the marine environment [2].

1.3. Criticism of the inclusion of CO₂ sequestration in the London Protocol

The non-government environmental organisation Greenpeace is generally unsupportive of CCS as a climate change mitigation technology, raising questions regarding safety and cost, while considering CCS as a distraction from efforts to accelerate the wider proliferation of renewable energy [3].

Members of Greenpeace have expressed concerns regarding the inclusion of CO₂ as a substance on the LP “reverse list”, allowing it to be considered for marine dumping in the sub-seabed. As an observer body to the LP, the organisation considers the decision to include CO₂ streams to have been made too hastily.

A particular concern of the organisation is the absence of reporting on the application of the Protocol’s Annex II and the CO₂ Specific Guidelines to offshore CO₂ storage sites which are currently being developed within the marine territories of some Parties to the Protocol [4]. The originally proposed P18-4 storage site of the ROAD CCS Project (Rotterdam, The Netherlands), and the proposed Goldeneye storage site of the Peterhead CCS Project (Peterhead, United Kingdom), are examples.

1.4. The P18-4 storage location

The P18-4 field is a near-depleted gas field at a depth of 3.5 km under the seabed, located approximately 20 km off the Dutch coast in the North Sea. P18-4 is one of a number of gas fields in the P18 and P15 licensing blocks on the Dutch continental shelf of which TAQA Offshore B.V. holds the production licenses. The gas production has reduced the field pressure from 350 bar to 20 bar, and the field has since been identified as a highly suitable CO₂ storage formation, with an approximate capacity of 8 Mt CO₂. The P18-4 field is produced through the P18-4A2 well, connected to the P18-A platform. The P18-4 field continues to produce a small amount of natural gas. Fig. 1 shows the approximate locations of the P18-4 and neighbouring gas fields.

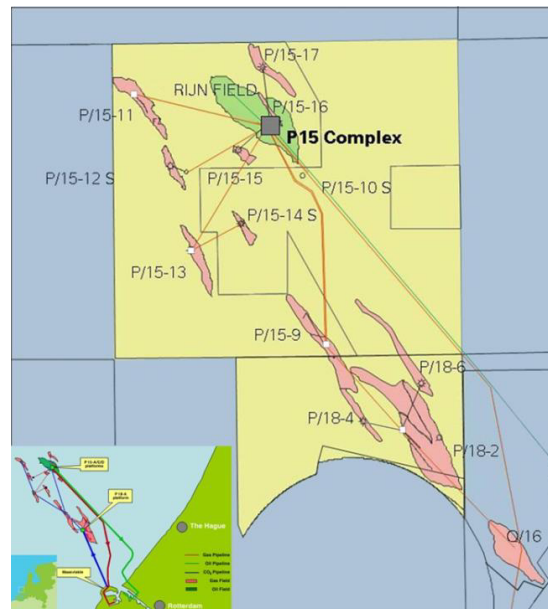


Fig. 1. The location of the P18-4 and neighbouring gas fields (Courtesy of TAQA Offshore B.V.)

After agreeing with the ROAD Project operators, E.ON Benelux and GDF Suez (now ENGIE Energie Nederland), to act as a CO₂ storage operator, in 2010 TAQA applied for a storage permit under the Dutch Mining Act. The application documents for the CO₂ storage were updated in 2011 to reflect changes in the Dutch Mining Act brought about by the transposition of the EU Directive of the geological storage of carbon dioxide (2009/31/EC).

Due to the steep fall in the price of emitting CO₂ under the European Union Emission Trading Scheme in 2009/2010, with the detrimental effect this has had on low carbon investments in industry, the ROAD Project has suffered severe delays from the original planned operational start of 2015. Despite this, TAQA received an irrevocable storage permit for P18-4 in September 2013.

2. Approach

2.1. Objectives

The objective of this report is to assess to what extent the proposed P18-4 storage site, originally part of the ROAD CCS Project, complies with the 2012 Specific Guidelines for disposal of CO₂ that have been agreed upon by the Parties of the London Protocol in 2007.

2.1.1. Justification for assessment

A comprehensive evaluation of the compliance of the P18-4 storage site with the requirements of the London Protocol has not been previously completed. The outcomes of this report can help inform the debate on the robustness of the regulatory framework for CCS, and the presence of overlap or gaps across relevant national, European and international legislation.

2.2. Methodology

This assessment employs a simple, but systematic cross-check of the requirements of the “2012 Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations” against the content of the “Supplement to the Application for a CO₂ Storage Permit in P18-4”.

The application for the CO₂ storage permit is a 643 page document primarily written in Dutch. The document contains the leading scientific information submitted by the storage operator, TAQA Offshore B.V., for examination by both Dutch national regulators (The Ministry of Economic Affairs) and the European Commission. The information submitted by the storage operator has been compiled to meet the requirements of the Dutch Mining Law on CO₂ storage, which comprises the requirements of the EU Directive on the geological storage of carbon dioxide (2009/31/EC).

Based on the information contained in the application, the National Authority has adjudged that both TAQA Offshore B.V. and P18-4 are in compliance with the requirements on the Dutch Mining Law with regards to CO₂ storage and issued an irrevocable storage permit in 2013.

This assessment has been implemented in in four sequential steps:

1. Cross-check compliance assessment of P18-4 application material with the London Protocol 2012 Specific Guidelines for CO₂ disposal
2. Report initial findings on compliance
3. Stakeholder consultation with storage operator and National Authority
4. Finalise findings

The stakeholders consulted are, TAQA Offshore B.V., and the Dutch Ministry of Economic Affairs, representing both the applicant and the National Authority.

2.2.1. Application material for assessment

There are 3 primary documents that are used for the assessment. As mentioned in the approach, the “Supplement to the Application for a CO₂ storage permit in P18-4”, including its 3 appendices and 4 annexes form the basis for the review. The “Environmental Impact Assessment CCS Maasvlakte (ROAD-CCS): Section Storage”, contains important considerations for the potential site-specific environmental effects that could be brought about by the storage activity.

The third document to be reviewed is the “Application for exemption from the Flora and Fauna Act”, which contains information regarding the possible environmental effects of the P18-A platform modifications (from where the CO₂ will be injected into P18-4), and the 20 km section of the offshore pipeline to transport the CO₂ from the capture unit to the platform. An overview of the documents, ancillary information, their authors and legal relevance is provided in Table 1.

Table 1. Application material assessed

Title	Author	Relevant legislation
Supplement to the Application for a CO ₂ Storage Permit in P18-4 (including appendices and annexes)	Royal Haskoning in commission of TAQA Offshore B.V. (2011) pp.1-643	Dutch Mining Act
- Appendix 1. Feasibility study P18	CATO-2 Dutch research programme on CCS (2010)	Dutch Mining Act
- Appendix 2. History and description of the P18 fields	PanTerra Geoconsultants B.V. (2011)	Dutch Mining Act
- Appendix 3. Fault integrity study	TAQA Offshore B.V. (2011)	Dutch Mining Act
- Annex 1. Risk management plan	Royal Haskoning in commission of TAQA Offshore B.V. (2011)	Dutch Mining Act
- Annex 2. Plan for corrective measures	Royal Haskoning in commission of TAQA Offshore B.V. (2011)	Dutch Mining Act
- Annex 3. Initial plan for closure	Royal Haskoning in commission of TAQA Offshore B.V. (2011)	Dutch Mining Act
- Annex 4. Monitoring plan – including overview of logging and monitoring tools, well integrity assessment P15-9 field, Flow assurance study	Royal Haskoning in commission of TAQA Offshore B.V. (2011) / Well Engineering Partners B.V. / TNO Technical Sciences	Dutch Mining Act
Environmental Impact Assessment CCS Maasvlakte (ROAD-CCS): Section storage	Royal Haskoning in commission of Maasvlakte CCS Project CV. (2011) pp. 1-404.	Decision on Environmental Impact Assessments 1994
Application for Exemption from the Flora and Fauna Act	TAQA Offshore B.V. (2011) pp. 1-74	Flora and Fauna Act




2.2.2. Definitions and assessment criteria

For the intent and purpose of this assessment, the definition of ‘compliance’ is as follows:

“In the application material submitted by the applicant, TAQA Offshore B.V., to the national authority charged with the granting of CO₂ storage permits, ‘The Dutch Ministry of Economic Affairs’, sufficient information has been provided to allow the national authority to evaluate whether the planned CO₂ storage activities can be implemented in a manner consistent with the provisions of the 1996 London Protocol.”

Each Specific Guideline requirement has been evaluated with a simple criteria provided in Table 2.

Table 2. Evaluation criteria for the assessment

	Sufficient information is provided
	Information or justification is partially sufficient but may require further clarification
	Insufficient information is provided

2.2.3. Limitations

The findings of the assessment has been restricted to identifying the presence of information, as submitted in the P18-4 storage application, which could be used by a Contracting Party of the LP to consider the CO₂ stream for

disposal, through the application of the 2012 Specific Guidelines. Whereas information deemed relevant has been assessed for completeness, it has not been reviewed scientifically.

It is assumed, that the requirements of Annex II of the LP, are fully incorporated into the contents and coverage of 2012 Specific Guidelines, whereby the latter can be considered the technical leading document, and is the leading document for the cross-check against the contents of the P18-4 permit application.

The “Risk Assessment and Management Framework for CO₂ Sequestration in Sub-Seabed Geological Structures” (RAMF) is considered supplementary to the 2012 Specific Guidelines and has not be used directly in the compliance assessment.

3. Overview of the P18-4 application procedure

In September 2009, the ROAD CCS Project was granted financial support from the European Commission under the European Energy Programme for Recovery (EPR). In May 2010, the project was also granted additional national support from the Dutch government. The final Environmental Impact Assessment and permit applications were submitted in June 2011. The permitting procedure for the entire ROAD Project involves a complex matrix of permitting requirements for the capture installation, the pipeline, platform and storage site, which cover all aspects of integration into built environment, interference with existing infrastructure, and an assessment of the project’s impact across all environmental media. Useful sources that outline the general permitting procedure for CCS projects in the Netherlands are available [5] [6]. An overview of the legislative requirements that the ROAD CCS Project has had to comply with is provided in Table 3.

Despite the myriad of permitting requirements needed for large multifaceted infrastructures such as a CCS demonstration plant, the number of permits needed for offshore CO₂ storage operations in the Netherlands are limited in number. For storage of materials at a depth of more than 100 metres, on or offshore, a storage permit under the Dutch Mining Act is required. In 2011, the contents of the EU CCS Directive was transposed into the Mining Act, the Mining Decree and the Mining Regulation. The aforementioned legal acts therefore contain the primary conditions for the application of a CO₂ storage permit in the Netherlands. The transposition of the EU CCS Directive also enforces the mandatory requirement for Environmental Impact Assessments (EIA) on capture installations, pipelines and storage sites, through the ‘Decision on Environmental Impact Assessments 1994’.

As required by the EU CCS Directive, the application for the storage permit was submitted to the European Commission for review in August 2011. In February 2012, the European Commission published its first Opinion on the draft storage permit, which was positive and asked for minor confirmations. The scope of the Commission’s Opinion was however limited to the draft storage permit, and not the proposed monitoring plan, risk management plan, corrective measures and post-closure plans. The plans were not considered mature enough to be operational at the point of submission. The plans were written in as complete a form as possible, but the Front End Engineering and Design (FEED) had not yet been conducted. The Dutch government has assured the Commission that operational plans will be submitted to the Commission for review prior to injection.

The final irrevocable storage permit was provided to TAQA in September 2013. Despite the storage permit being irrevocable, the above mentioned plans must be agreed and in place, as well as a financial security being made available, prior to the start of injection, in accordance with the Dutch Mining Act.

Table 3. Legislative requirements relevant to the ROAD CCS Project

Legislative requirement	Law	National Authority	Applicant
Environmental Impact Assessment (Capture, Transport, Platform, Storage)	Environmental Protection Act	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment; Province of Zuid-Holland (delegated to DCMR (Environmental Protection Agency for the Rotterdam Area))	Proponent (Maasvlakte CCS Project C.V. owner of the ROAD CCS Project)
Emission permits (for capture, transport and storage); Environmental Permission; Building Permission	Environmental Protection Act	Dutch Emission Authority	Proponent
All-in-one permit for physical aspects (Capture, Transport)	General Environmental Conditions Act	Province of Zuid-Holland (delegated to DCMR (Environmental Protection Agency for the Rotterdam Area))	Proponent
Natural Protection Act Permit	Nature Protection Act 1998	Province of Zuid-Holland	Proponent
Water Permit	Water Act	Ministry of Infrastructure and Environment (delegated to the State Water Authority, Department South Holland)	Proponent
State Zoning Plan	Spatial Planning Act	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment	Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Infrastructure and Environment
Water Permit	Water Act	Ministry of Infrastructure and Environment (delegated to the State Water Authority, Department Zuid-Holland)	Proponent
Railway Permit	Railway Act	ProRail	Proponent
Flora and Fauna Act Exemption	Flora and Fauna Act	Ministry of Economic Affairs, Agriculture and Innovation	Proponent
All-in-one permit for physical aspects (Platform modifications)	General Environmental Conditions Act	Ministry of Economic Affairs, Agriculture and Innovation	TAQA
Storage Permit	Mining Act	Ministry of Economic Affairs, Agriculture and Innovation	TAQA

4. Overview of the “Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations” of the P18-4 application procedure

The inclusion of CO₂ streams onto the reverse list of the London Protocol in February 2007, triggered the establishment of the CO₂ Working Group by the London Protocol Scientific Group. The CO₂ Working Group was tasked with the development of a set of guidelines which could support the relevant authorities of LP Parties to consistently enforce the requirements of Annex II of the LP. In November 2007, the “Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations” were adopted by the Parties to the LP. In 2012 the Specific Guidelines were amended to include some additions on transboundary storage and/or movement of CO₂, and the confirmation of the application of these guidelines for projects involving the storage of CO₂ exported from foreign countries.

The Specific Guidelines has been developed to:

“deal with risks posed by carbon dioxide sequestration in sub-seabed geological formations over all timescales and primarily at the local and regional scale and thus focus on the potential effects on the marine environment in the proximity of the receiving formations.”

The “risks” associated with carbon dioxide sequestration in sub-seabed geological formations are defined as those associated with the leakage of CO₂, but also any other substances present in the gas stream or substances which have been mobilised by the gas stream in the subsurface.

The Specific Guidelines are structured as follows:

1. Introduction
2. Waste prevention audit
3. Consideration of waste management options
4. Chemical and physical properties
5. Action list
6. Site selection and characterisation
 - a. Characterization of the sub-seabed geological formation
 - b. Characterization of the marine area under consideration
 - c. Evaluation of potential exposure
7. Assessment of potential effects
 - a. Evaluation of potential effects
 - b. Risk assessment
 - c. Impact hypothesis
8. Monitoring and risk management
 - a. Mitigation or remediation plan
9. Permit and permit conditions

The structure of the Specific Guidelines has been adopted as a basis upon which the assessment of the P18-4 permit application documents has been completed.

5. Results of the compliance assessment

With reference to Fig. 2 below, based on the assessment conducted, information has been provided by the applicant to cover at least 82% of the requirements of the Specific Guidelines for CO₂ sequestration in sub-seabed formations. Eight requirements are deemed to require attention or clarification where only partial information has been submitted, or where the requirement would appear non-applicable. Only one requirement of the Specific Guidelines is considered to be insufficiently addressed in the permit conditions. Fig. 3 provides an overview of the results of the compliance assessment per Section.

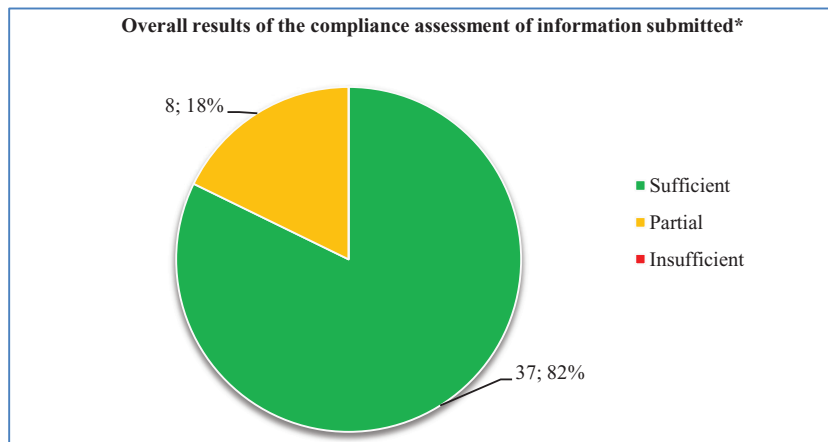


Fig. 2. The overall results of the compliance assessment with regards to information submitted by operator. * Totals do not include the assessment of Section 5 - Action List, and Section 9 Permit and Permit Conditions, as these are the responsibility of the National Authority

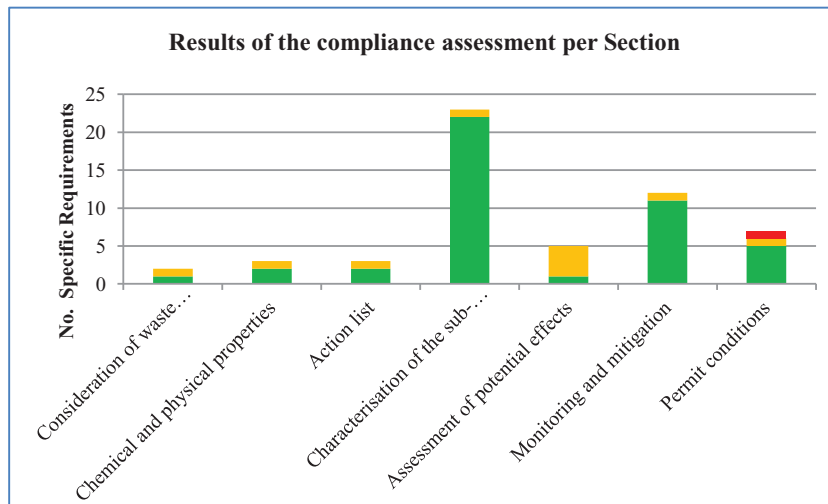


Fig. 3. Results of the compliance assessment per Section

The full detailed analysis of the assessment can be found in [7].

6. Conclusions

In the case of the P18-4 CO₂ storage permit, the material submitted to the National Authority is broadly sufficient to allow an evaluation of the planned CO₂ storage activities in a manner consistent with the provisions of the 1996 London Protocol. Based on the information submitted by the applicant, no information was sufficiently absent that would indicate clear non-compliance with the CO₂ Specific Guidelines.

There are, however, eight areas from within the application material whereby the information or justification is partially sufficient, but may require further clarification. In addition, there is also one area of partial compliance and one of non-compliance from within the permit conditions which is the responsibility of the National Authority. The one area which could be considered as non-compliant with the London Protocol refers to the absence of clear temporal intervals upon which the storage permit must be reviewed. This requirement was absent from the P18-4 storage permit as issued by the Dutch government.

Overall, this exercise demonstrates that the requirements of the CO₂ Specific Guidelines are relevant and achievable by national regulators and CCS projects, and that transparency of compliance assessment is possible in ensuring the protection of the marine environment.

7. Recommendations

In light of the outcomes of this assessment, a number of recommendations are derived. The recommendations are relevant both for this specific case study, but also for future CO₂ storage permits in marine territories of contracting parties. The recommendations are categorised according to stakeholder group:

7.1. Recommendations to the National Authority

- It should be requested that within any future permit applications, that the applicant makes a statement recognising the applicability of the 1996 London Protocol and the requirements of the Specific Guidelines for Assessment of Carbon Dioxide for Disposal into Sub-seabed Geological Formations.
- Recognizing the focus of the London Protocol on protecting the marine environment, the applicant should provide a clear statement on the foreseen effects of CO₂ leakage on the marine environment, including seawater, sediments and biota. The statement should be based on the outcomes of the risk assessment. Should the outcome of the risk assessment indicate a negligible risk to the marine environment, and this is acceptable to the National Authority, no further site-specific effects assessment of CO₂ on the local marine environment would seem applicable. If pre-existing information is available on the marine communities, tidal effects, sediment conditions, etc. at the site or at a similarly indicative area, these could be considered for inclusion. There are several EU projects which may be useful in this respect, such as RISCS, QICS and ECO2.
- The applicant should explicitly highlight an “Impact Hypothesis”, which could be an additional concise statement as part of the outcome of the standard risk assessment.
- For future permit allocations for CO₂ storage sites provided by the National Authorities of Contracting Parties, it is recommended that a brief summary of conformance with the requirements of the 1996 London Protocol is included in the preamble to the permit conditions. The summary should focus on the Impact Hypothesis and demonstrate that consideration has been given to the marine communities at the storage location.
- If it has been decided not to develop an Action List, due to a limited number of CO₂ streams for storage, this should be explicitly mentioned as part of the LP compliance summary recommended above.
- The National Authority should ensure that fixed intervals for permit review are explicitly mentioned in the

permit conditions.

7.2. Recommendations to the London Protocol

- Clarification could be sought on the extent to which the applicant must comment on the economic and operational feasibility as a consideration in the selection of a sub-seabed geological formation for the disposal of CO₂ streams.
- Clarification could be sought on the extent and nature of public participation recommended in the permitting process of CO₂ storage sites, given a lack of experience and suitable legal provisions for enforcing such participation in some Contracting Parties.

Acknowledgements

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