

Italian legislation and first experimental project of CO₂ geological storage in a depleted gas field

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1. Italian Regulation on CO₂ underground storage

2009



Directive 2009/31/EC of the European Parliament on the geological storage of carbon dioxide

2011



The Legislative Decree No. 162 of 14/09/2011

- ✓ establishes the first CCS regulatory framework regulating in particular the authorization procedures and other activities related to CO₂ storage in line with the provisions of Directive 2009 31 /EC-I

2020



Law decrees n. 76/2020 and 77/2021 introduce amendments to Legislative Decree No. 162 of 14/09/2011

2021

- ✓ introduce simplified procedure for experimental storage programs referring to depleted hydrocarbon reservoirs,
- ✓ at the same time as the exclusion of the subjection to EIA for programs involving a volume of less than 100,000 tons.

2023



Law Decree No. 181/2023 introducing further amendments to Legislative Decree No. 162 162 of 14/09/2011

- ✓ Depleted offshore reservoirs are defined as suitable areas ex lege
- ✓ CCS supply chain study
- ✓ CO₂ transport technical rule

2. Exploration and storage permits issuing: the projects evaluation chain

MASE - Ministry of Environment and Energy Security

Competent Authority (CA) for issuing storage permits (administrative)

ETS COMMITTEE National Committee for the Management of Directive 2003/87/EC and for the support of Kyoto Protocol project activities
Responsible for issuance of technical evaluation of the project.

Technical Secretariat for Underground CO₂ Storage.

Technical body within the ETS Committee for scientific and technical support in the evaluation of storage projects

National Scientific-Technical bodies

ISPRA (TWG on CCS)
INGV

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3. 1. Inspections and environmental control activities

Storage permits issued by CA contain the provisions of the ETS Committee, as well as measures, requirements, and monitoring actions for the operator.

In order to monitor the compliance of CCS activities with the permit provisions and no substantial changes are made to the facility not previously authorized, the rule requires inspections to be carried out by:

UNMIG

for overseeing the implementation of mining police regulations and for technical support to the Committee under the Technical Secretariat

ISPRA

for the supervision of environmental monitoring actions carried out by the operator on the storage complex also using the Regional Agencies for Environmental Protection (SNPA) and for technical support to the Committee within the Technical Secretariat

National Fire Brigade Body

responsible for verifying the adoption of all technical and management measures aimed at risk control and management of emergency situations.

3. 2. Inspections and environmental control activities

Inspections and control activities include:

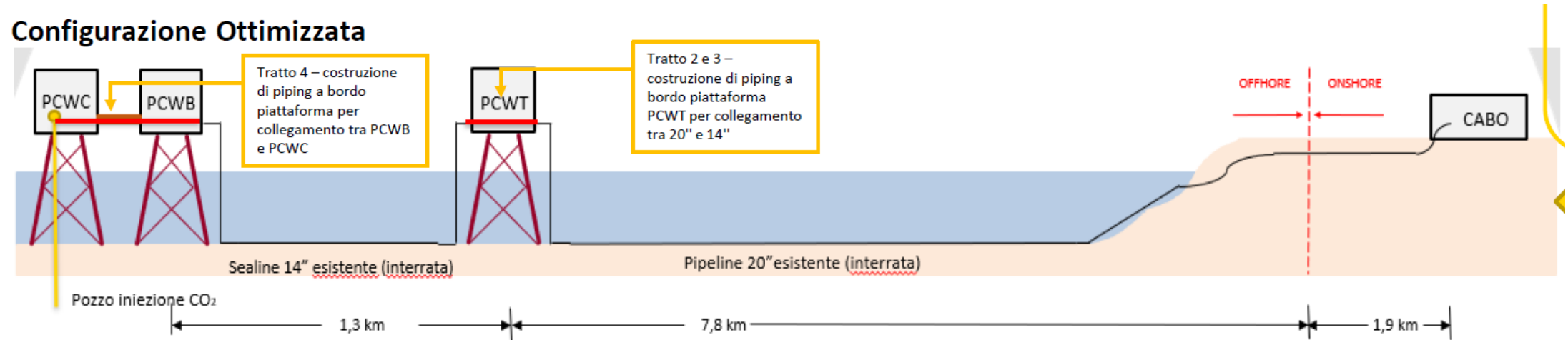
- a. periodic inspections (every 1, 3, 5 years depending on the cases provided for in the decree)
- b. occasional in cases where the ETS Committee, on the recommendation of the supervisory and control bodies, deems it appropriate and in any case:
 - ✓ in cases of significant irregularities or accidental releases;
 - ✓ in case of non-compliance with the conditions set forth in the permits;
 - ✓ following reports of hazards to the environment or public health and safety.

4. Safety and environmental protection requirements

According to Law Decree No. 162/2011 the operator of the plant, in the project application submitted to the competent authority, must report:

- the characterization of the storage site (ANNEX I)
- assessment of storage security (ANNEX I)
- monitoring plan (now mandatory also for experimental programs below 100K tons) (ANNEX II)
- the plan on corrective actions containing measures to prevent significant releases and technical plant irregularities, procedures and measures to minimize CO₂ leakage risk, as well as measures to contain harmful effects resulting from releases (ANNEX II)
- plan for the post-closure phase (ANNEX II)
- demonstration of the applicant's technical and economic capacity (ANNEX III)

5. First experimental project



The first experimental CO₂ geological storage project in Italy was authorized on 26 January 2023. The project consists:

- capture of the CO₂ produced in an onshore plant;
- transfer by means of existing sealines to offshore platforms in the Northern Adriatic Sea;
- injection and permanent storage in a depleted level of a natural gas field located at a depth over than 2000 meters for a total volume of injected CO₂ of 50,000 tonnes with a maximum duration of two years (about 25,000 tonnes per year).

The thickness of the water column in the affected area ranges from 0 to 18 meters.

6. Technical assessment

As this is the first CO₂ storage project a precautionary approach was adopted under which further aspects of environmental protection not only concerning the security of the storage complex were also analyzed.

The operator has been called to set up:

- the reconstruction of the static geological model,
- the generation of the 3D dynamic model (simulation of CO₂ injection condition)
- the geophysical monitoring of soil deformations network
- the microseismic monitoring network
- the evaluation of tsunami risk
- the emergency management procedures,
- the computation of emissions of pollutants in the offshore and onshore environments generated during construction of plant.

Accidental leakage of CO₂ was also considered, through model simulation of the dispersion and transport of CO₂ and analysis of the potential effects on the marine environment, generated by hypothetical and unlikely CO₂ release (also on-shore)

7. Ecological Risk Assessment

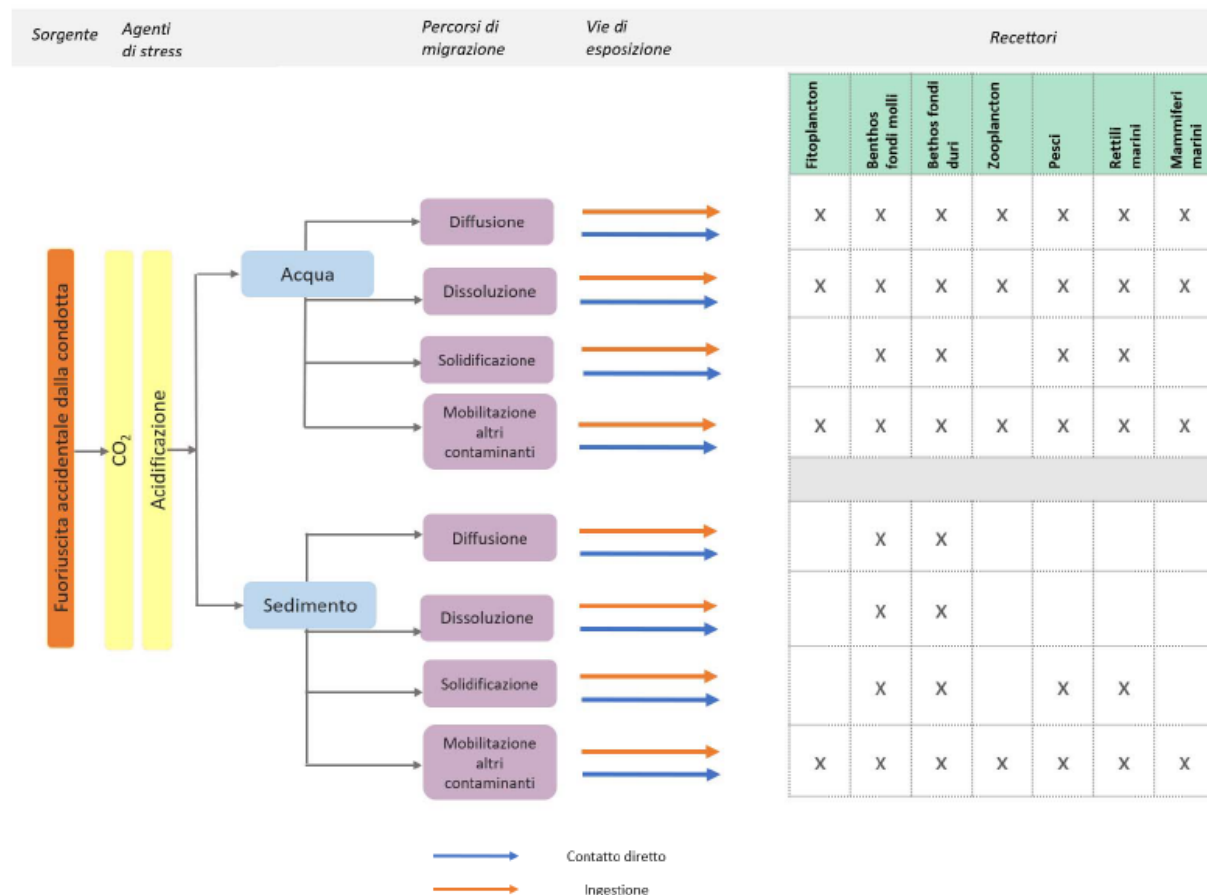
Two different CO₂ release worst scenarios investigated

- Pipe Break (6 inch)
- Pipe Leak (1 inch)

Analysis of consequences

An analysis of the consequences on aquatic organisms due to water acidification and thermal shock has been carried out:

- Fitoplancton
- Benthos
- Zooplancton
- Fishes
- Marine reptiles
- Marine mammals



8. Monitoring activities

Although, at the time of application and authorization, regulation did not request a mandatory Monitoring Plan, specific monitoring activities were planned (Off-shore & On-shore) .

Potential CO₂ leakages to the surface, even if not likely, will be detected through well monitoring and environmental monitoring.

- **Well monitoring** must verify that the performance of the injection process, in terms of injection rate, physical and chemical conditions of the injected fluid, expected pressures and plume migration, occur according to model predictions, and at the same time CO₂ confinement is guaranteed. This monitoring is planned both before and during the injection, to measure the effects at the reservoir level, in the cover (caprock) or at the surface.
- **Environmental monitoring** aims to detect any leakage through a series of multidisciplinary surveys. It includes geophysical surveys of the seabed and the water column, acoustic surveys (leak detection), physical, chemical and biochemical surveys of water and sediments. Monitoring activities will also consider the impact to marine fauna potentially attributable to changes in the chemistry of marine waters, mainly originating from the reduction of pH values.

9. Main requirements of the permit

- The injection facility must be equipped with automatic injection shut-off systems in case of deviation of the fluid composition from the authorized limits detected by continuous CO₂ and CO measurements.
- As a maximum pressure limit at the bottom of well the Operator shall not exceed 24MPa (240bar approx.) The Operator shall place at the bottom of well dedicated instrumentation for continuous detection of pressure and temperature of the injected fluid.
- The Operator shall implement a microseismic network considering realistic estimates of background seismic noise. Preventive monitoring at the beginning of the activities will also have to be carried out, in order to be able to verify unperturbed conditions (ante operam requirement).
- With regard to ground deformation monitoring, the Operator shall install new GNSS stations, part offshore, on each existing platform currently lacking such instrumentation in order to better track deformation at the CO₂ storage reservoir.
- If noise levels potentially impacting the species *Tursiops truncatus* and *Caretta caretta* are exceeded during these operations, appropriate mitigation measures will have to be applied, such as the use of bubble curtains or other acoustic mitigation measures, temporal shifting of operations to protect the most sensitive periods of the species involved.

10. Conclusion and future directions

The Law Decree 162/2011 provided for the issuance of several ministerial decrees to regulate specific aspects of the activity , which have not been implemented in the following years.

Although DL 181/2023, has addressed some of these shortcomings there are still provisions yet to be implemented

Currently in the short term are being implemented :

- **CCS supply chain study** - Elaboration of a study aimed at, among others, conducting the reconnaissance of the current regulations related to the CCUS supply chain, elaborating schemes for the technical-economic regulation of CO2 transport and storage services including modalities for the remuneration of the different stages of the CCUS supply chain. To be issued a Law Decree regulating the modalities of access to the networks.
- **CO2 transport technical regulation** - Ministerial Decree on the technical rule for the design, construction, testing, operation and supervision of transport infrastructure and services.

Thanks for the attention!

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