Effects of CO_2 Leaks Offshore

With most capture facilities being onshore, with the exception being gas processing facilities at sea, the principle offshore leakage potential routes are from subsea pipelines or storage formation leaks.

Leak Sources

Offshore transport of CO_2 would either be by pipeline or ships, with the CO_2 transported as a dense gas or liquid. Any leak would involve the pipe or ship storage tank rupturing, and would need repair to prevent the leak. Pipelines again could be shut down remotely, as with onshore pipelines, but the ship-based leak would be a more lengthy process, however it would also be much less likely to occur. Leaks from sub-seafloor storage reservoir would occur in the same way as onshore storage formations, but the detection and remediation actions would differ.

Offshore Transport

Operators of oil and gas production facilities have relevant experience of transporting high-pressure fluids and gases through seafloor pipelines. The extent of the experience in the offshore environment is less than the onshore equivalent, but the best source of experience and knowledge comes from the Snøhvit gas processing and CO_2 capture and storage (CCS) facility in the Barents Sea (Norway). Here the site operators have been processing natural gas produced from below the sea floor and storing the CO_2 since 2008 without incident, and the operators have contributed a great deal to the knowledge base used in the CCS industry as a whole.

Specific issues faced by offshore transport that do not apply to onshore situations are primarily around material selection and resistance to corrosion. Submersing metal pipelines in salt water adds a complexity and expense to these pipelines not present in onshore transport situations. Ships used for transport of liquids and dense gases are designed for purpose, and use double hulls to prevent leaks even in the event of an accident or running aground.

Leakage Risks and Prevention Measures

CO_2 leakage into seawater could cause the CO_2 to dissolve into the seawater, making it become more acidic which could have a detrimental affects on some sea life. The exact impact would be determined by the immediate environment; the existing chemical makeup of the seawater, the temperature, depth, pressure and the currents in a specific location. Mixing of the affected water and non-affected water by currents would lessen any effects.

The risks associated with leakage from the storage site would be similar to those described above, as the impacts would come into force once the CO_2 reached the seabed and was dissolved into the sea water. Remediation of any leaks from the storage reservoir would be similar to that in onshore reservoirs, although the costs of operating offshore and below the sea would be higher.

Once again, it needs to be highlighted that the probability of leakage from a carefully selected storage formation, deep under the seabed is extremely unlikely. Taking the Sleipner project example in the North Sea, monitoring has shown the CO_2 to have remained safely within the storage formation for many years, acting as predicted by scientific models. The chances of leaks are extremely small but even if a leak did occur, monitoring and remediation options are more than capable of stopping leaks and preventing damage to the environment.

Summary

Again, leakage is possible in offshore storage operations, but every measure would be taken to minimise or remove the opportunities for incidents. The risks remain fairly similar to those of onshore situations, and the monitoring, detection and remediation of any leaks would be similar, but with the added complexity of operating under the sea.

Although the risks are still present in offshore CCS, and although they are more expensive to remediate, the fact remains that the risks are extremely small, and the technologies and abilities to remediate leaks are in place and ready.