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Risk Management Plan – The Key to a Successful CCS Project

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Summary

Robust risk management plans are essential for a CCS project to succeed. They must be site-specific and contain five key steps, including 1) establishing the context, 2) risk assessment, 3) risk treatment, 4) communication, and 5) monitoring. Risk assessments quantify risk hazard (likelihood x severity) and uncertainty, enabling the identification of risk treatment options. The risk management plan establishes the foundation for Measurement, Monitoring & Verification (MMV) and informs the project design and the site characterization plan.

Theory / Method / Workflow

Multiple standards exist that inform geological carbon sequestration. For example, the Canadian Standard Association (CSA), the International Standard Organization (ISO) and the Project Management Institute (PMI) have published documentation relevant to risk management for carbon sequestration [1,2,3,4]. In addition, the Government of Alberta recently published guidelines specific to Measurement, Monitoring & Verification (MMV) in March 2022 [5]. This latest document mandates all CCS proponents in Alberta to "Accurately assess site-specific risks and plan to manage them [at all project stages]."

Assessing site-specific risks is easier said than done. Too many CCS proponents will revert to generic assessment protocols rather than performing a thorough, bottom-up approach of relevant risks. The PCOR partnership and the National Energy and Technology Lab (NETL) have identified this as a shortfall within the industry and each has introduced a "Best Practices Manual" to help the industry navigates risk assessment and MMV. [6,7,8]

A proper site-specific risk management plan needs to include five key steps:

1. Establishing the context
2. Risk assessment
3. Risk treatment
4. Communication
5. Monitoring

Establishing the context is the first step of a risk management plan. This initial step is initiated at management level of the project in order to define the scope of the risk assessment. It requires defining the storage systems and boundaries. The risk criteria (schedule, cost, function, reputation, etc.), severity level, and likelihood level all need to be defined.

Risk assessment is the second step of the risk management plan. This step is comprised of workshop(s) where the project technical team and external experts can collaborate. The risk assessment involves identifying risks relevant to the site and compile them into a risk register. These risks are then analysis to assess severity and likelihood at a pre-mitigation level. Where

possible, quantification method should be employed, however most early CCS project will revert to experts' opinion in the absence of quantifiable data. Then, the risks are evaluated by calculating the hazard (severity x likelihood) and placed on the figure 1 below.

Figure 1: Risk Assessment Matrix (RAM)

A Conceptual Site Model (CSM) is a simplified representation of the storage complex that can be employed to facilitate risk identification. Compiling participants score as opposed to attempting to reach group consensus allows to track uncertainty between participants for any given risk.

Risk treatment is the third step of the risk management plan. This step builds on top of the risk assessment. Risks deemed uncertain are assess for further analysis or data gathering is added to the site characterization plan. Risk hazard beyond the proponent's tolerance threshold is assessed for either transference, avoidance or mitigation. Risks within the tolerance threshold or without alternative treatment options have to be accepted.

Communication is essential to any CCS project. This step is done internally within the proponent organization (and partners) but also externally to any stakeholders within the area.

Monitoring is beyond the scope of this paper. A robust risk management plan will lead to a site-specific risk assessment that will set the stage for meaningful monitoring technology deployment.

Results, Observations, Conclusions

A robust risk assessment allows to plot all project risks on a hazard vs uncertainty scatterplot. Both axes can then inform meaningful risk treatment options. Figure 2 is showing an example of the risk distribution on a CCS project.

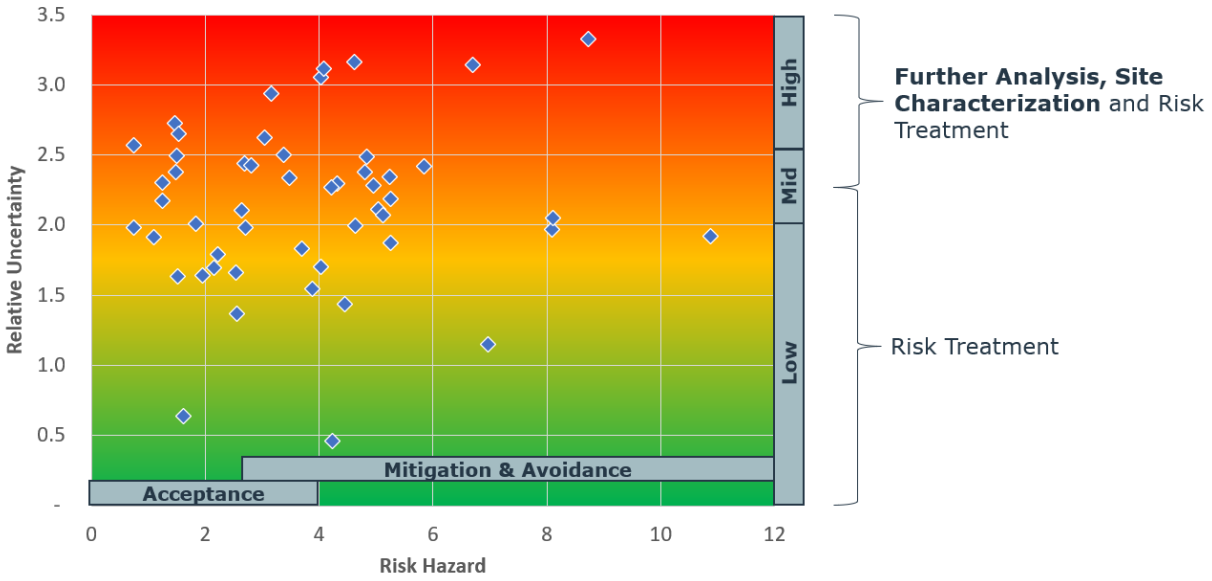

Figure 2: Risks Hazard vs Uncertainty

Risk treatment options have an impact on a given risk severity and likelihood when implemented. A post-mitigation level can be established assuming the actions are implemented. The figure 3 shows the impact of mitigation on the risk hazard profile. Risk moving below the unit line are associated with positive mitigation option. The risk remaining on the unit line or devoid of mitigation options will have to be accepted or avoided by modifying the project design.

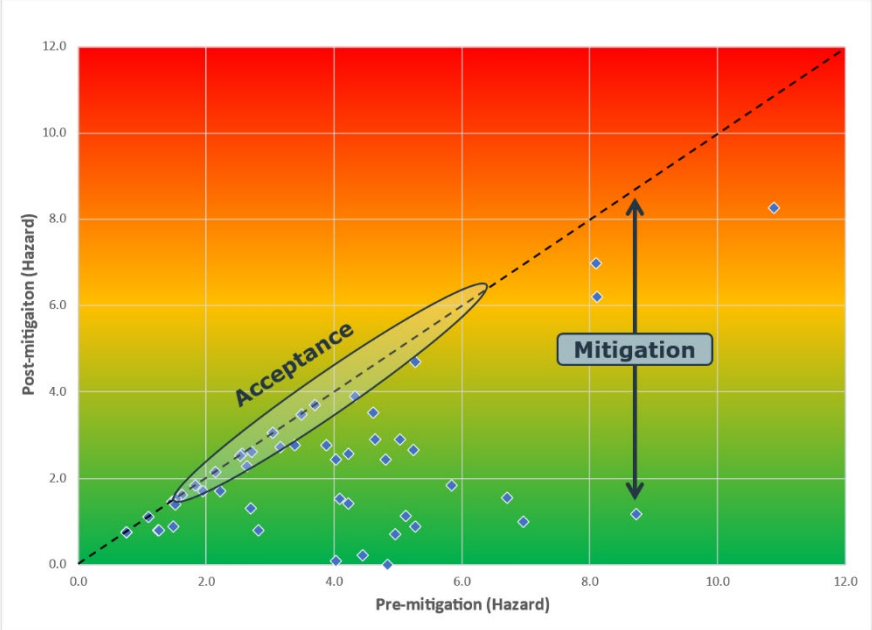

Figure 3: Risk Pre- vs Post-Mitigation Hazard

Novel/Additive Information

The risk management plan is often presented as a step toward building a MMV document. The true to the matter is the risk management plan goes well beyond that. The project design and the site characterization plan should also be derived from this crucial step. This leads to the requirement to do a thorough site-specific risk assessment not just prior to submitting a MMV to the government but also prior to conducting any subsurface operation.

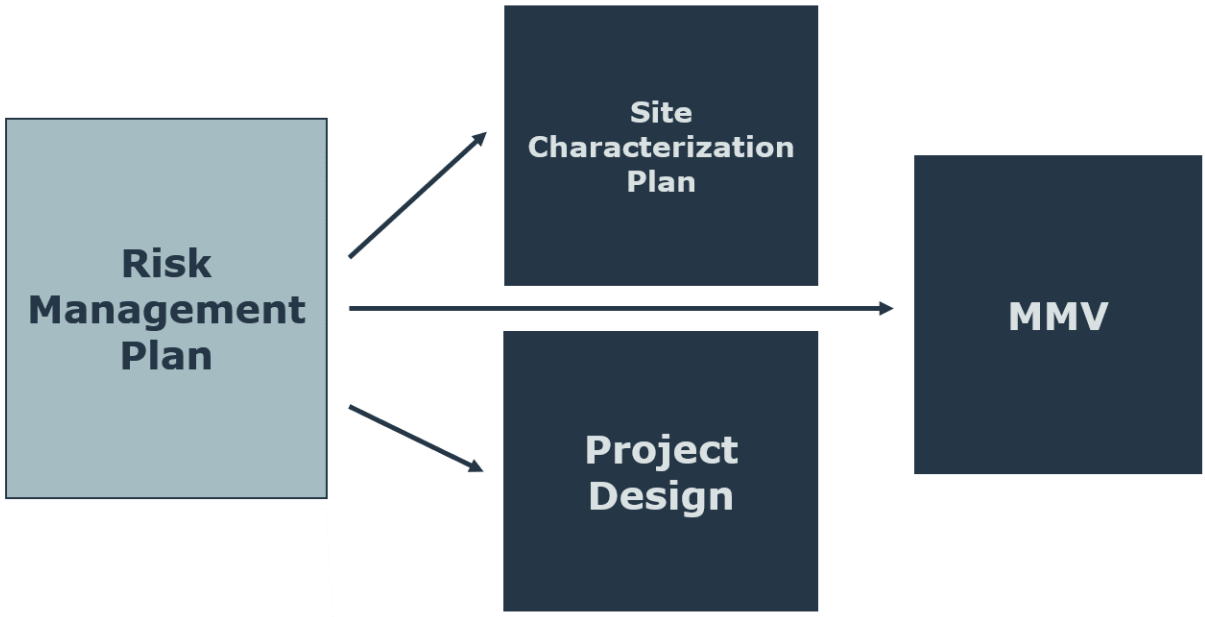

Figure 4: Risk Management Plan is feeding into many key parts of a CCS project.

References

Standards & Guidelines

1. CSA Z741-12(R2018). Canadian Standard Association – Geological storage of carbon dioxide
2. ISO 27914:2017. Carbon dioxide capture, transportation and geological storage. Geological Storage
3. ISO 31000:2018. Risk management—guidelines
4. Project Management Institute [PMI], 2008, A guide to the project management body of knowledge
5. Monitoring, Measurement and Verification Principles and Objectives for CO2 Sequestration Projects. Alberta Energy. Version 1, March 2022.

Best Practices Manual

6. PCOR Partnership Best Practices Manual for Subsurface Technical Risk Assessment of Geologic CO2 Storage Projects. 2017-EERC-10-21.
7. Best Practices_Monitoring, Verification, and Accounting (MVA) for Geologic Storage Projects. DOE, NETL-2017/1847. Aug 2017.
8. PCOR Partnership Best Practices Manual – Monitoring for CO2 Storage. 2018-EERC-03-15.