Assessing the Expansion of US Carbon Storage Infrastructure: Materials Suitable for CO_2 Injection and Monitoring Wells

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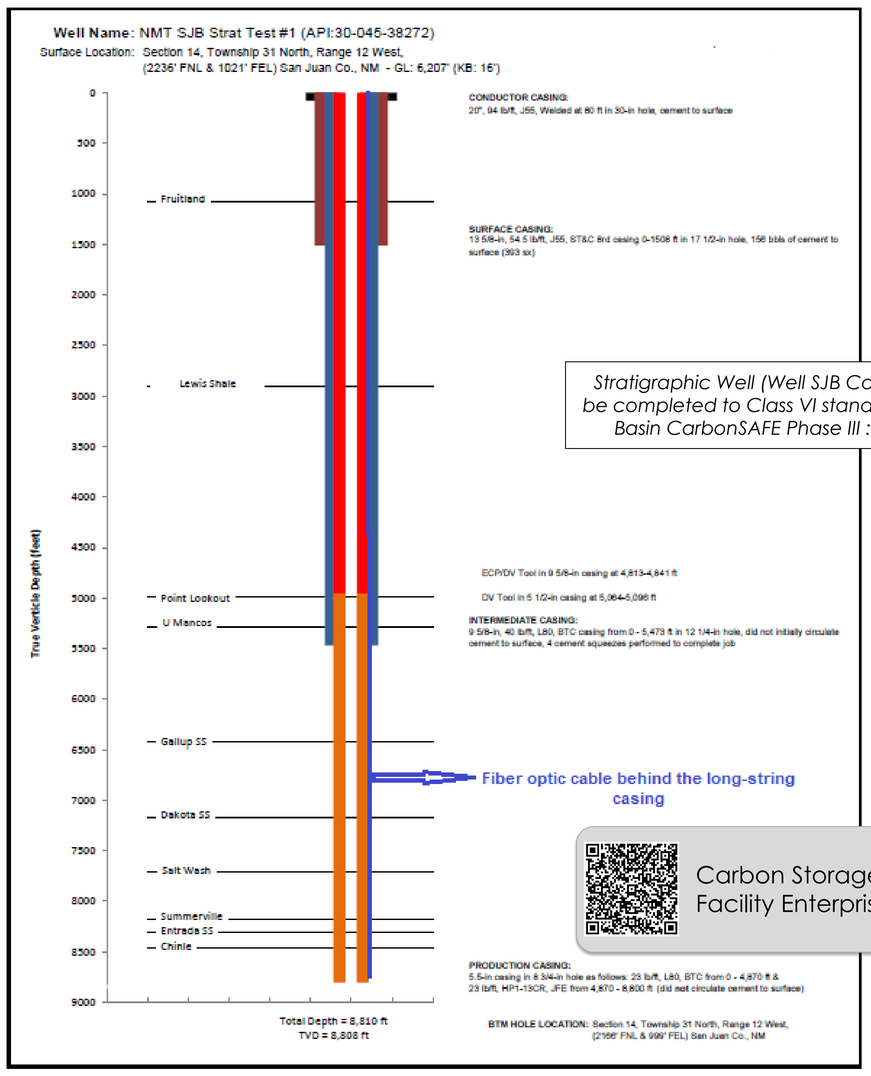
Overview of critical materials used in construction of carbon storage wells – CarbonSAFE

Objective: Assessing risks (cost, delays) associated with procurement of materials for CO_2 injection and monitoring wells in U.S. DOE carbon storage programs (e.g., CarbonSAFE Initiative).

Some of the items identified are tubulars both carbon steel and corrosion-resistant alloys (CRA) material, packers and other downhole tools, wellheads, and CO_2 resistant cements. Of these components, the tubulars represent the largest spend per well in the carbon storage sites. The estimated total carbon steel requirement for tubular goods in the CarbonSAFE projects (Phase IV: Construction) is expected to be less than 2% of the current domestic demand from the oil and gas industry.

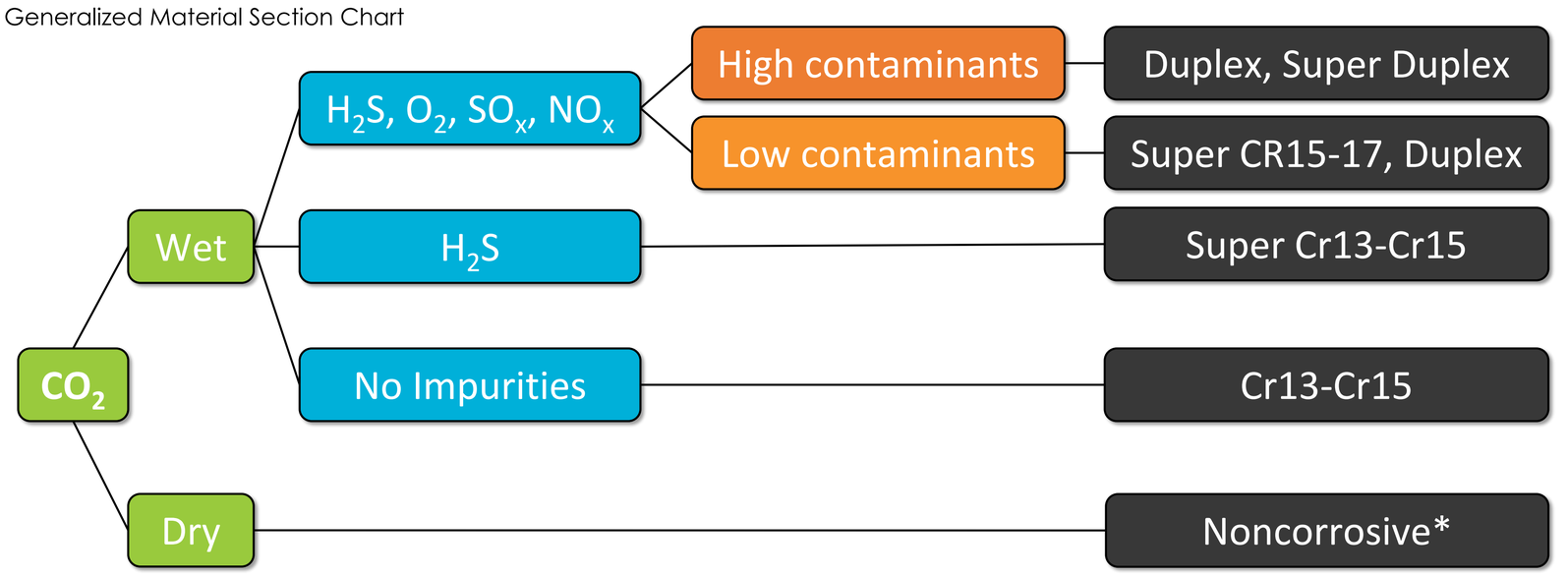
CRA required for critical sections of CO_2 injection and monitoring wells are more expensive than carbon-steel equivalents and have thus far been sourced and manufactured entirely from abroad in CO_2 injection projects to date. Domestic mills have the potential to employ the hot rolled processes necessary for Cr13-17 and Cr22-25 range products, but current market conditions do not support domestic production.



Stratigraphic Well (Well SJB CarbonSAFE #1) to be completed to Class VI standards for San Juan Basin CarbonSAFE Phase III : DE-FE0031890

Carbon Storage Assurance Facility Enterprise(CarbonSAFE)

Generalized Material Section Chart



* If H2s is present, Cr13 might be needed

Important factors for material selection:

- Pressure, temperature, pH
- Redox potential at in-situ application
- Chloride concentration
- Presence of other species

Is Cr13 adequate for CO_2 injection?

Yes, but varies location to location. Corrosion tests at varying impurities, pressures, and temperatures provide crucial information to verify longevity of the infrastructure. In-situ conditions affecting the material choice are both external/environmental and Internal/metallurgical.

The CRA alloy to be used needs to be evaluated for each site.

Is the current state of carbon steel and CRA tubular goods sufficient to meet the needs of the growing CCS Industry?

Yes, there is a surplus of world production. Cr13 materials have been employed for CRA purposes in CO_2 injection and monitoring wells to date, with both raw materials and tubular goods manufacturing sourced entirely from abroad by companies such as JFE, Vallourec and NKK. However, projects will not be able to rely on existing CRA tubular goods inventory but will need to order material from abroad.

Wellbore Material	Domestic supply available?		Risk to CarbonSAFE*
	Materials	Product	
C-steel casings and tubulars	Yes	Yes	Low
CRA casings (Cr 13- 17)	No	No	Significant
CRA casings(Cr 22 – 26)	No	Yes	Low
Packers	No	No	Significant
Wellheads	No	Yes	Significant

* low, where adequate domestic supplies of materials currently exist with typical lead times under 8 months; and significant, where materials and/or products are primarily sourced from outside the U.S., and lead times may exceed 8 months

Increasing lead times will **require projects to plan** rather than relying on inventory to meet demands for these materials.