



Deep Borehole Field Test Emplacement Cost Estimates

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**DBFT Engineering Support Services
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Outline

- Overview
- Assumptions
- Cost Drivers
- Operational Alternatives
- Cost Uncertainties
- Summary

Overview

- Comparison of emplacement costs for DBFT based on Handling and Emplacement Options Report
- Costs based on actual case histories and communication with vendors
- Actual costs may vary significantly depending on final designs and operating conditions

Assumptions

- Wellbore completion activities complete
- Does not include waste package and instrumentation costs
- Emplacement costs are based on rental prices
- No “trouble time”
- Cost differences between wireline and drill string emplacement
- 400 consecutive days of operation

Cost Drivers

■ Time

- Daily charges for rig
- Canister delivery time

■ Geography

- Location of disposal site
- Mobilization charges (e.g. CT cementing)

■ Temperature

- Cementing costs (retarders)

■ Market

- Availability of rigs and specialty services depends on oil & gas market
- Lead times for casing and tubular goods

Operational Alternatives

■ Rent or Buy?

- Dictated by frequency of operation

■ Single emplacement with drill pipe?

■ Cellar for wireline option

- CT cementing may require a level pad for mobilization

Cost Uncertainties

■ Time-dependence

- Actual duration of project?

■ Location selection and disposal method

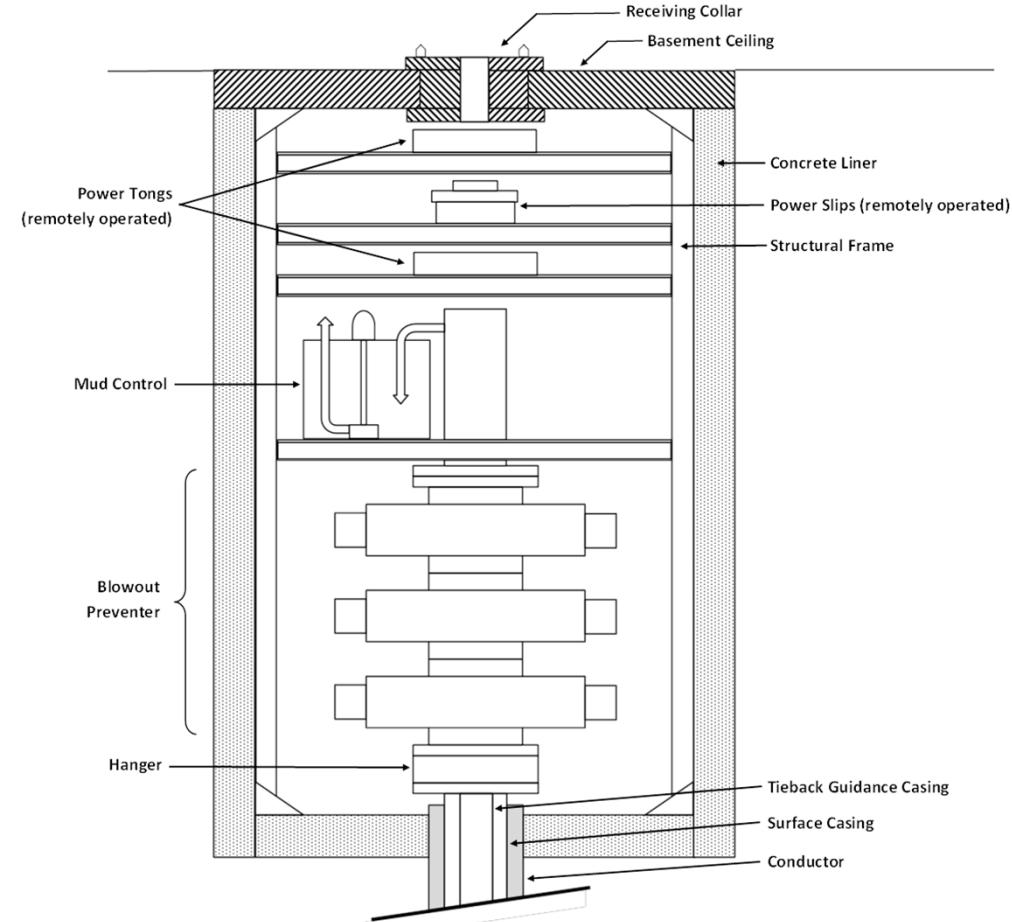
- Drives periodic operation costs (plugging, cementing)

■ Site preparation and construction

- Limited design details
- Order of magnitude estimates

Drill String Handling & Emplacement Required Components

- Basement construction
- Surface pad installation
- Transfer carrier installation
- Workover rig
- Control room



Drill String Emplacement

■ Time-Dependent Costs

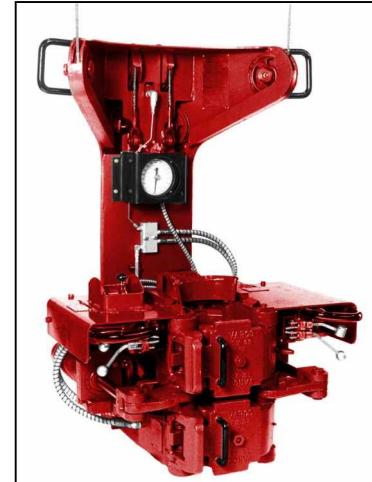
- Drill rig
- Iron roughneck
- Power tongs
- Power slips
- BOP stack

■ Intermediate Plugging Costs

- Bridge plugs
- Cementing

■ One-Time Costs

- Build pad and cellar
- Build structural frame
- Build transfer track system
- Final sealing and rig-down



NOV power tongs



Wrangler Roughneck 120™



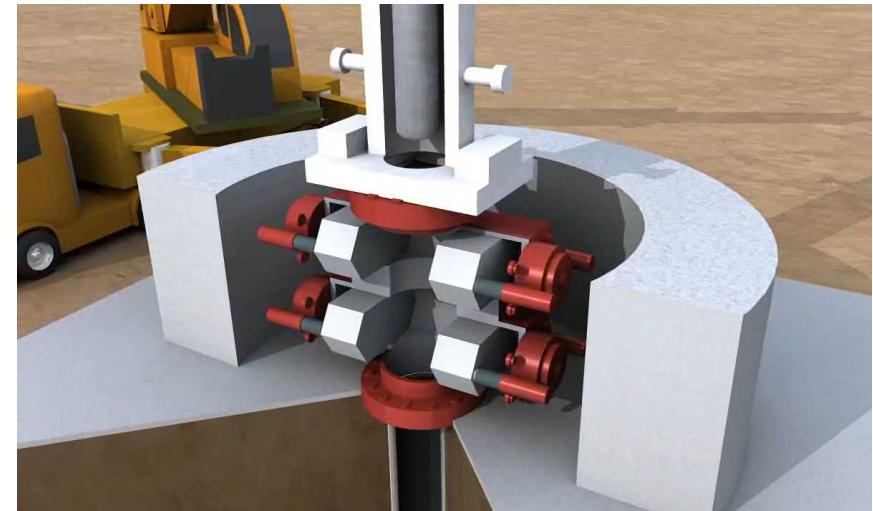
NOV power slip

Drill String Emplacement Costs

	Component	Daily Cost	Total
Time Dependent Costs	Drill rig	\$75,000	\$30,000,000
	Iron roughneck	\$3,000	\$1,200,000
	Power tongs	\$1,000	\$400,000
	Power slips	\$3,000	\$1,200,000
	BOP stack	\$2,500	\$1,000,000
	Sub-total		\$33,800,000
Intermediate plugging costs	Bridge plug	\$10,000	\$90,000
	Cementing	\$40,000	\$360,000
	Sub-total		\$450,000
One-time costs	Build pad and cellar		\$500,000
	Build structural frame		\$100,000
	Build transfer track system		\$300,000
	Final sealing and rig-down		\$1,000,000
	Misc. costs		\$200,000
	Contingency		\$500,000
	Sub-total		\$2,600,000
Total Project Cost			\$36,850,000

Wireline Handling & Emplacement Required Components

- Surface pad
- BOP shield
- Hoist and wireline
- Cable head
- Crane
- Ancillary equipment
- Workover rig
- Control room



Wireline Emplacement

■ Time-Dependent Costs

- Wireline unit
- Crane
- BOP stack



■ Intermediate Plugging Costs

- Bridge plugs
- Coiled tubing unit and cementing

■ One-Time Costs

- Build pad and control room
- Build radiation shield enclosure
- Final sealing and rig-down



Wireline Emplacement Costs

	Component	Daily Cost	Total
Time Dependent Costs	Wireline unit	\$37,000	\$14,800,000
	Crane	\$15,000	\$6,000,000
	BOP stack	\$2,500	\$1,000,000
	Sub-total		\$21,800,000
Intermediate plugging costs	Bridge plug	\$10,000	\$90,000
	Coiled tubing unit and cementing	\$200,000	\$1,800,000
	Sub-total		\$1,890,000
One-time costs	Build pad and control room		\$350,000
	Build radiation shield enclosure		\$50,000
	Final sealing and rig-down		\$1,000,000
	Misc. costs		\$200,000
	Contingency		\$500,000
	Sub-total		\$2,100,000
	Total Project Cost		\$25,790,000

Summary

- Costs depend on location and other factors as well as method
- Uncertainty in estimates
- Wireline is potentially less costly