DATA SHEET

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Blowout Analysis and Relief Well Kill Simulation
Relief Well Design

DECISIONSPACE® 365 ENTERPRISE | WELL CONSTRUCTION

Digital Well Program® blowout analysis, relief well planning and well kill procedures

Take control of your well design and well control planning requirements through multi-disciplinary blowout analysis, relief well planning and well kill procedures using automated engineering workflows.

FEATURES

- Features an iterative process that connects blowout analysis, relief well planning and well kill procedure.
- Automatically calculates the potential blowout rates for multiple pre-defined Worst Case Discharge scenarios
- Performs probabilistic and risk-based analysis of calculated worst case discharge rates and uncontrolled flow durations.
- Uses historical blowout data and distribution statistics to improve accuracy and reliability.
- Standardized relief well planning and integrated well engineering applications ensure consistent, automated, and auditable results.
- Rapidly generates several relief well intercept plans for any open hole section, from the conductor all the way to total depth.
- Leverages industry-established intercept methods for relief well plans.
- Generates a relief well design that contains the optimum relief well trajectory and well kill requirements for 12 worst case discharge scenarios.
- Automatically determines the well kill solution, from dynamic kill to static kill phase, for any one selected worst case discharge scenario, while ensuring the wellbore pressures stay within a safe margin from corresponding fracture pressures.
- The workflow facilitates the inclusion of various sensitivities in the blowout analysis and relief well kill calculations.

Overview

Planning for a relief well is a collaborative and iterative process involving multiple disciplines from subsurface to well design and engineering. To help meet the regulatory requirements, Drilling Engineers resort to third-party services to generate blowout analysis, build relief well trajectories and run dynamic kill calculations.

Ultimately, operators are faced with multiple challenges which, if not solved could lead to:

- Delays in finalizing well programs
- Reduced operation agility
- Increased costs
- No visibility or control over well control and well kill simulation turnaround and results due to lack of digital integration
- Relinquishing building internal expertise, even for standard well design scenarios, where digitalization can provide effective and efficient solutions

The Digital Well Program® Blowout Analysis and Relief Well (BARW) planning workflow solves key challenges that Drilling Engineers are presented with. Its implementation in Digital Well Program® represents an important Digital Engineering Integration milestone accomplishment, transforming the traditional Industry Compartmentalization of advanced and complex well design studies done by domain experts into a practical and easy to use software tool accessible to all.

Access to this application on the Drilling Engineer's own schedule, will allow flexibility and more timely results, especially when the relief well planning and modeling need to be run multiple times when a well plan goes through revisions and design gates.

How does it improve well planning?

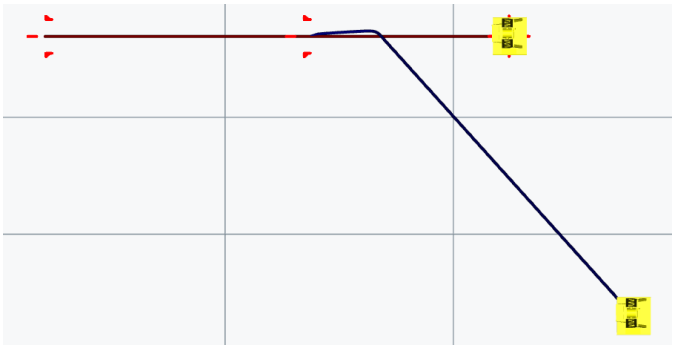
The bespoke, unified workflow, built within the Digital Well Program® solution delivers a set of flow calculations and Relief Well Kill solutions for worst-case well control scenarios. It enables Drilling Engineers to assess the potential worst case discharge rates under multiple pre-defined scenarios early in the well design stages, optimize designs to reduce and mitigate drilling risks, and generate viable Relief Well Plans for any of the selected uncontrolled flow scenarios.

This workflow can help ...

- Fast-track offshore drilling permits and kick-off drilling campaigns through quicker government regulations compliance.
- Accelerate the process of performing reliable blowout analysis and relief well planning due to digital integration.
- Optimize expenditure by reducing well capex cost by performing blowout analysis and relief well planning in-house.
- Improve safety and operational agility by removing dependency on third-party services and reports.
- Drilling Engineers gain full visibility and control over their own well design and simulations by being involved in the simulation and planning process.
- Brings reservoir modeling and well design together in a more seamlessly integrated engineering model.
- Optimize well designs by including blowout analysis, relief well planning and well kill procedure workflows in the well design process.
- Builds internal expertise, even for standard well design scenarios, where digitalization can provide effective and efficient solutions.

How is this different from other solutions?

The Blowout and Relief Well Planning workflow is superior to other solutions in its ability to generate highly standardized and consistent plans with accurate estimations which in turn help to significantly minimize risk and uncertainty.



By accessing the blowout analysis engine, the Drilling Engineer will determine the potential worst- case discharge rates for multiple pre-configured uncontrolled flow scenarios in adherence to the regulatory guidelines. This highly iterative workflow provides users with the flexibility to perform sensitivity analysis while taking into consideration various uncertainties around reservoir properties, well functional specifications, and well kill parameters.

WORST CASE DISCHARGE TABULAR RESULTS (SURFACE)

RELEASE POINT	RESERVOIR EXPOSURE	FLOW PATH	OIL RATE (bbl/D)	GAS RATE (Mft³/D)	FBHP (psi)	IPR
Surface	Partial	OH	367	14665	100.33	☑
		ANN	360	14376	246.96	☐
		DP	349	13920	474.17	☐
	Full	OH	1091	43560	289.76	☐
		ANN	1029	41058	693.93	☐
		DP	937	37386	1259.14	☐

WORST CASE DISCHARGE TABULAR RESULTS (SEABED)

RELEASE POINT	RESERVOIR EXPOSURE	FLOW PATH	OIL RATE (bbl/D)	GAS RATE (Mft³/D)	FBHP (psi)	IPR
Seabed	Partial	OH	355	14153	358.42	☐
		ANN	351	14026	421.74	☐
		DP	343	13697	583.7	☐
	Full	OH	1067	42607	445.44	☑
		ANN	1017	40592	767.53	☐
		DP	930	37135	1296.61	☐

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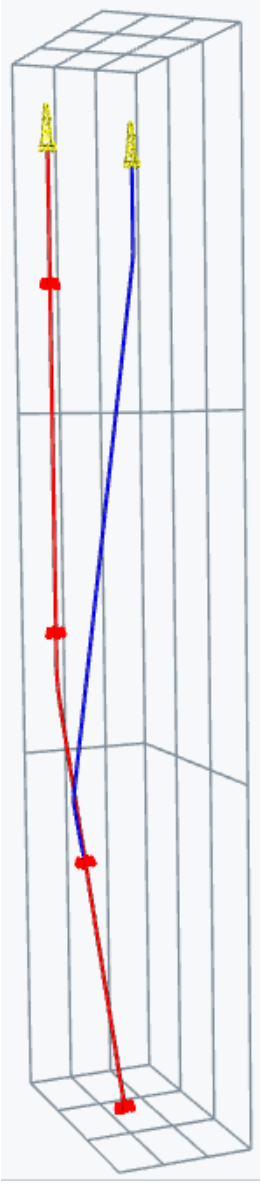
Furthermore, using historical blowout data and distribution statistics, the user can run probabilistic and risk-based analyses of calculated worst-case discharge rates and uncontrolled flow durations.

Within this workflow, the user has the ability to generate several relief well intercept plans for any open hole section from the base of the conductor all the way to total depth, using 3 industry-established intercept methods, in sync with our DecisionSpace® Well Planning software relief well trajectories planning functionality.

WEIGHTED WORST CASE DISCHARGE RATES (SEABED)

TOTAL RISK SUM: **100.00** TOTAL RISKED OIL RATE: **616.37** TOTAL RISKED GAS RATE: **24611.65**

RELEASE POINT %	RESERVOIR EXPOSURE %	FLOW PATH %	BOP STATUS %	TOTAL RISK %	RISKED OIL RATE (BBL/D)	RISKED GAS RATE (MFT³/D)
Seabed: 44	Partial: 60	OH: 0	Open: 30	0.00	0.00	0.00
			Restricted: 70	0.00	0.00	0.00
		ANN: 87	Open: 30	15.66	54.97	2196.47
			Restricted: 70	36.54	128.26	5125.10
		DP: 13	Open: 30	2.34	8.03	320.51
			Restricted: 70	5.46	18.73	747.86
	Full: 40	OH: 17	Open: 30	2.04	21.77	869.18
			Restricted: 70	4.76	50.79	2028.09
		ANN: 72	Open: 30	8.64	87.87	3507.15
			Restricted: 70	20.16	205.03	8183.35
		DP: 11	Open: 30	1.32	12.28	490.18
			Restricted: 70	3.08	28.64	1143.76



Continuously running the fully automated Well Kill solution iterations on the Target Well and Relief Well plan designs, that includes Dynamic Kill, Reduced Rate and Static Kill phases, the drilling engineer can quickly determine the safe kill procedures such that optimum kill solution is obtained for the selected blowout scenario with minimal effort.

Being able to control and help optimize the well design, while including the worst case discharge simulations and well kill analysis, is a big leap forward to achieving a safe and reliable well design.

The automated well kill solution generates a blowout analysis, relief well plan and well kill procedure in just 4 steps:

- Blowout analysis, statistic, and probabilistic risk-based analysis
- Automated relief well intercept trajectory solution using industry-standard archetypes
- Comprehensive automated well kill solution covering the entire well kill procedure
- Create well control blowout, relief well plan and well kill report

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Transparency of fundamentals and methodologies

Detailed fundamental science and engineering methodologies and digital documentation support each workflow step, to empower Drilling Engineers to accurately perform the applicable blowout analysis, relief well planning and well kill procedures.

What it seeks to replace?

The application replaces the need to consult third-party services, reduce cost and improve time to reach first order analysis. It can also significantly minimize the domain knowledge gap for in-house Drilling Engineers.

Key Takeaway

This Digital Well Program workflow can be seamlessly integrated within an organization's existing well design process to generate a standardized, automated relief well by connecting the blowout simulations with relief well planning and well kill procedure. The workflow fully integrates with Digital Well Program, NETool® software and Engineer's Desktop™ (EDT™) software for consistent, automated, and auditable results.

"Performing Blowout and Well Kill simulations in-house by the responsible Drilling Engineer will ultimately give us more ownership of this part of the well planning. Understanding all aspects of the actual case and its limitations is crucial for reducing the probability of major hazards."

- Drilling Engineer

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