



MULTI-WELL PAD WELL CONTROL CONSIDERATIONS & RESPONSE



Incidents Frequency

Wild Well Answers the Call

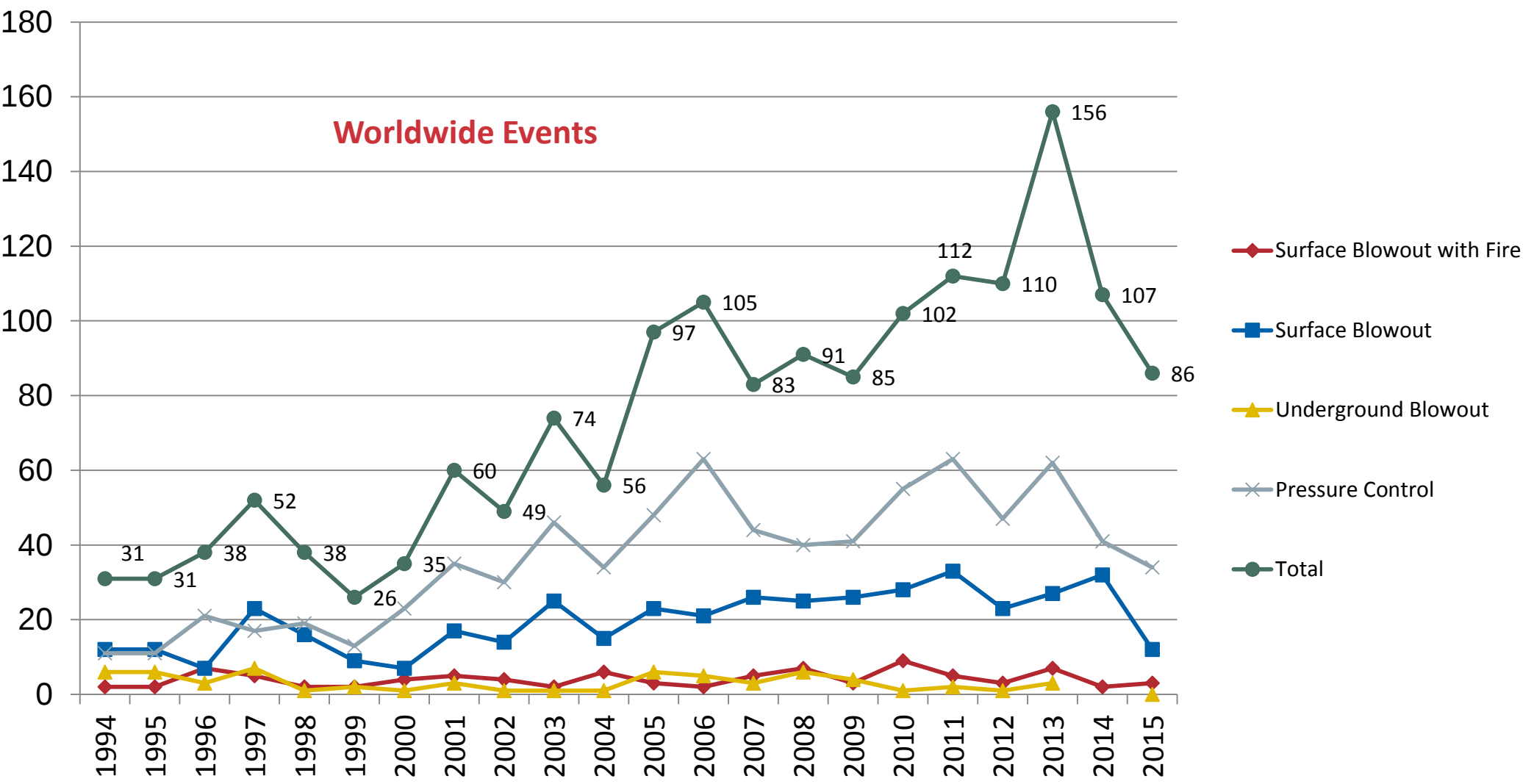


#1 in call-to-action
response

80% of international events
85% domestic events



Annual Well Control Statistics



Blowouts Do Not “Just Happen”

- Documented facts show that over 80% of major catastrophes involve a chain of 7-11 separate contributing factors (or warning signs) before a catastrophe occurs.

Blowouts Are NO Different!



New Risks for Today's Operations

- Complex/multiwell, high-pressure frac operations
- Crew experience vs complacency
- Multiwell pads
- Suburban settings
- Simultaneous operations at the wellsite
- Higher pressures being drilled
- Lack of certified well control equipment
- Aging field/well integrity issues
- The Great Crew Change



Leading Risks/Factors

Crew Experience

- Lack of understanding and/or knowledge of well control principles/practices
- Low level of awareness or concern of well control issues
- Reliance on technology alone to understand well control signs
- Crew complacency during drilling operations
- Lack of proper training of well control equipment and/or systems
- Lack of drills

A stylized graphic of flames in a lighter blue shade, located in the top-left corner of the slide.

Multi-Well Pads

A horizontal bar spanning the width of the slide, divided into three segments of yellow, red, and orange.

Multi-Well Pads



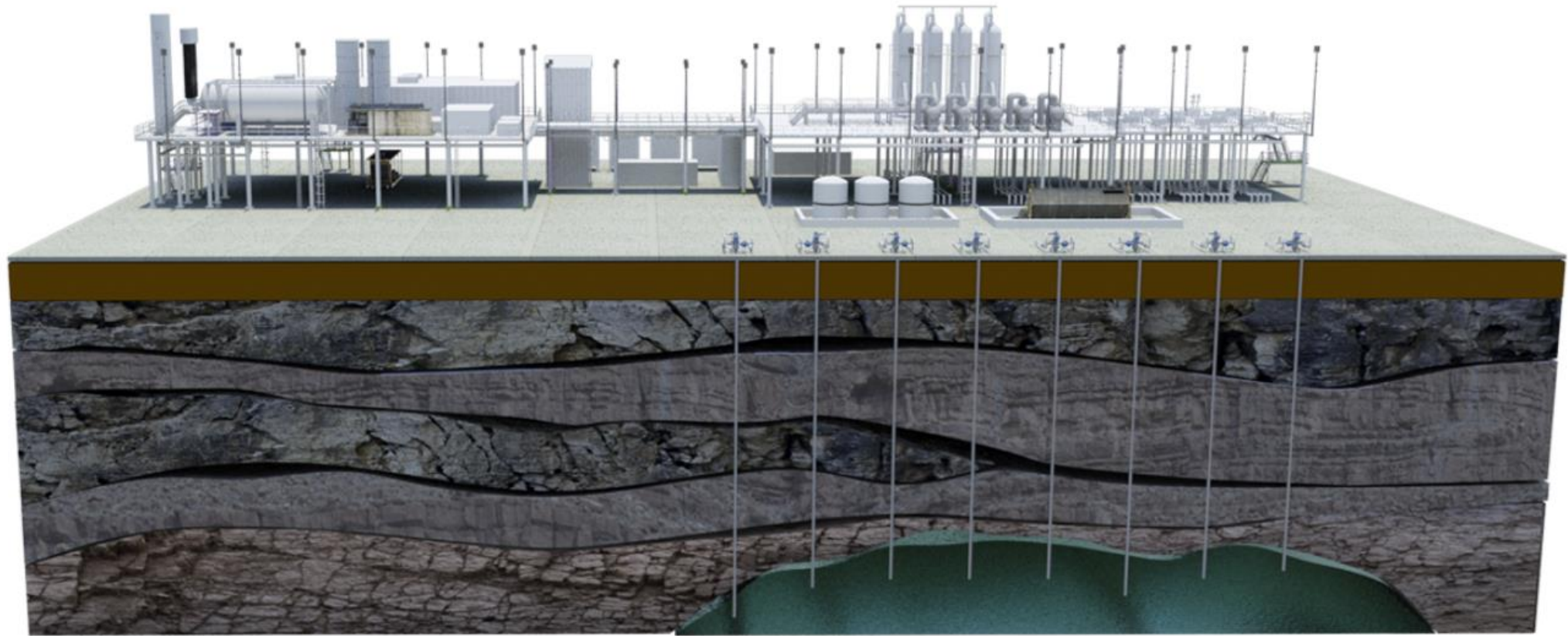
Freeze Operations on Multi-Well Pad



Multi-Well Pad Benefits

- Economics- throughout the drilling, completion and production stages having multiple wells at a single pad site has many economic advantages.
- Land Space- regardless of a single well or multiple wells per pad the required pad size is typically the same. This allows operators to better plan well placements as well this opens up the ability to work with the land owner for rural and urban development.
- Consolidated Resources- with multiple wells at a single pad site typically specialized rigs are incorporated to drastically reduce move times. This benefit carries over to the completion and production aspect as well.
- Ease of Well Monitoring- well monitoring times are greatly reduced by allowing the monitoring of multiple wells at a single stop.

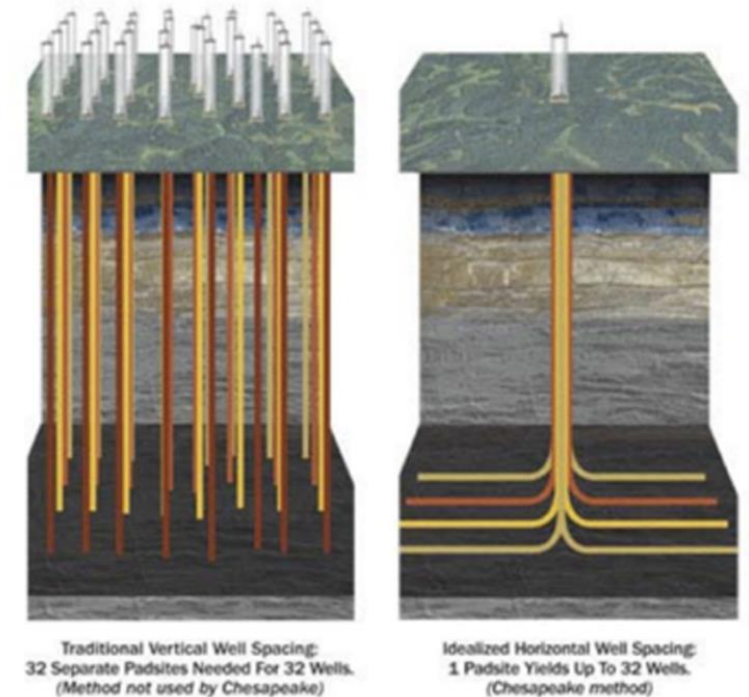
Multi-Well Pad Gas Storage Facility



Gas Storage Reservoir

Multi-Well Pad Benefits

- Ease of Regulatory Monitoring- operators have a greater ability to monitor, inspect and react according to local regulatory guidelines with multiple wells at a single location.
- Reduced Environmental Impact- with multiple well assets on a single pad the environmental impact is greatly reduced from lease roads, tankage, pipelines, etc.



Continuous Multiwell Frac Operations

Additional risk exposure
vs
cost savings



SIMOPS (simultaneous operation)

- The entry of multi-well pads has also opened up the ability to perform SIMOPS on a pad site. This has benefited the completion side of the industry by allowing multiple well interventions to take place simultaneously.
- Adjacent wells can be prepped during stimulation with coiled tubing, wire line and or flow back services. The completion process can be sped up dramatically with reduced non-productive time between stages.
- This is a relatively new concept that can be performed safely and efficiently with proper planning and preparation.

Simultaneous Ops – Drilling and Completion Ongoing



Blowout

- Blowouts occur when a well can no longer be controlled from surface by mechanical means or downhole by way of kill weight fluids or a mechanical barrier.
- Blowouts can consist of single phase formation fluids of oil, gas or water or can be a combination of these formation fluids.



Loss of Well Control



Blowout

- Blowouts can occur at surface through failed pressure control equipment, through failed tubulars such as the casing and can also occur subsurface (underground blowout). Subsurface blowouts occur when uncontrolled reservoir fluids flow from a higher pressured formation into a lower pressured formation.
- It is not un-common to have both a surface and subsurface blowout occurring simultaneously.
- The appropriate reaction to a blowout is directly proportional to the type of blowout occurring.



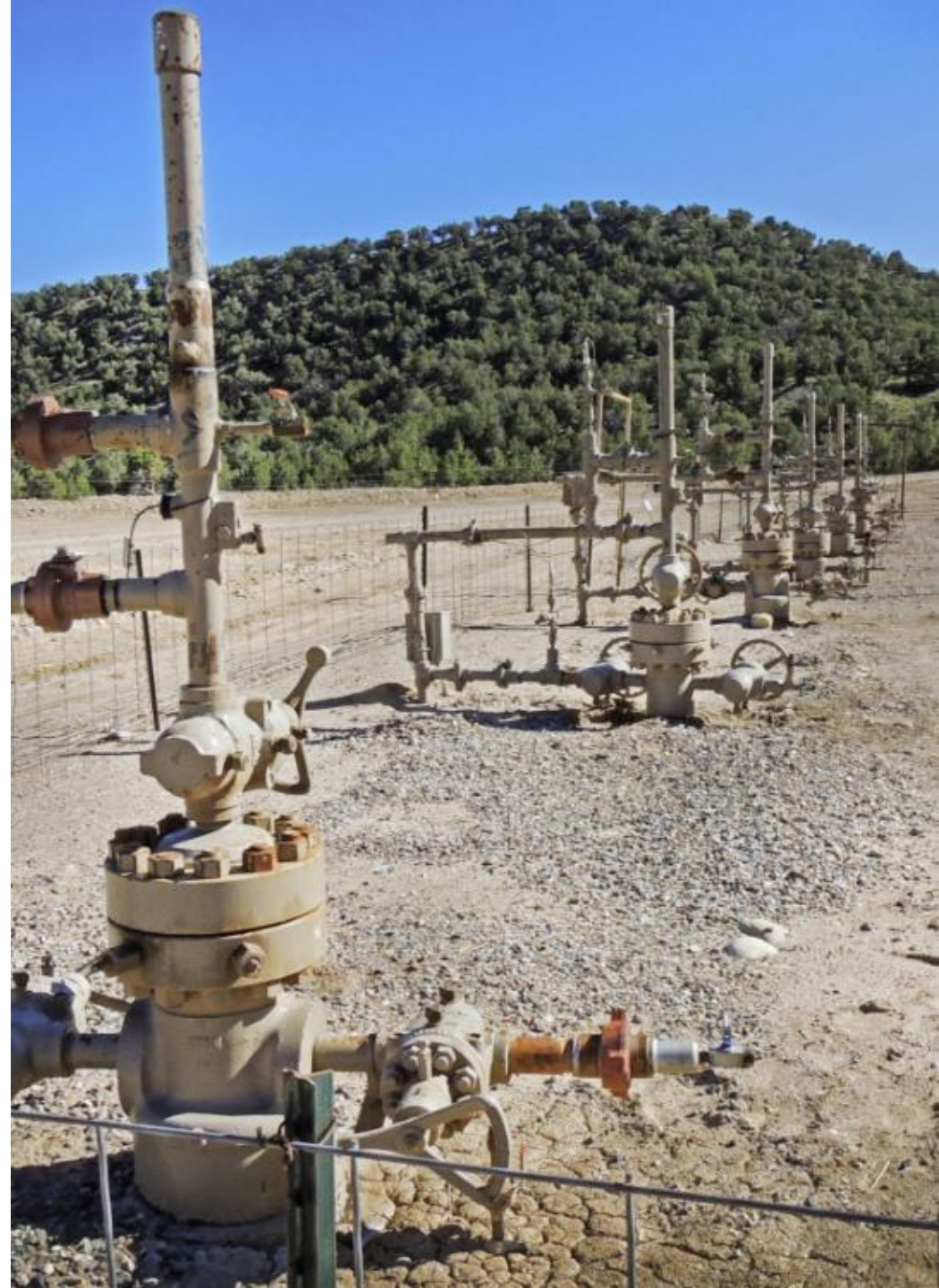
Reaction & Considerations

There are several variables to anticipate for controlling a blowout, however there are certain methods and interventions that should be considered in multi-well pad blowouts.

- Containment
- Approach
- Wind
- Radiant Heat Shielding
- Broaching
- Relief Well
- Emergency Well Kill and T&A
- Snubbing and or Coiled Tubing Intervention
- Emergency well capping

Reactions & Considerations

- Containment at the pad site early on is crucial
 - Earth moving equipment
 - Berms & barriers
- Approach angle
 - Capping operations and other interventions typically require straight forward approaches
 - Excavating may be necessary
 - Well proximity can complicate these operations

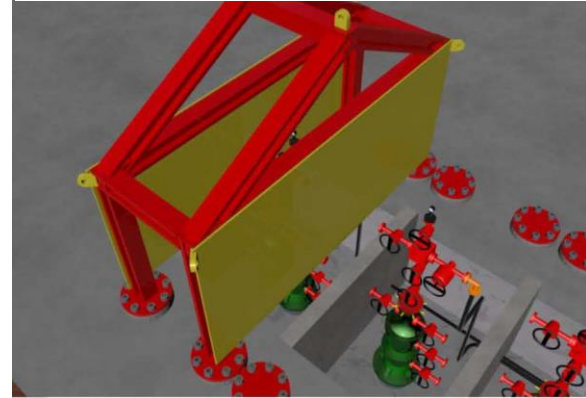


Design Considerations

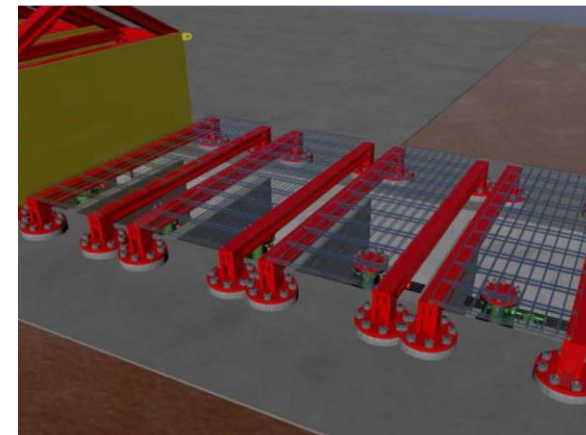
- Wellhead setting depth
- Common Cellars
- Blast Walls
- Wellhead spacing
- Capping considerations
- Fall Protection



Wellhead Design With Two (2) Submerged Valves. Pneumatic Valve Located Above Ground Level.



Common Cellar with Fall Protection and Upper Reinforced Steel Plate Blast Shields



Common Cellar Wells without Production Trees with Compact Fall Protection Beams

Reactions & Considerations

- Wind
 - Wind direction and topography play a big role during capping and well control ops.
- Radiant Heat Shielding
 - Wild Well can construct and advise on placement of heat shielding. Radiant heat can have adverse affects on adjacent wells.
- Broaching
 - Depending on the depth and severity of the broach there are multiple ways to engage the well
 - Well proximity and spacing is vital

Reactions & Considerations

- Relief Well
 - In some instances a relief well may be necessary to intercept the blowout well.
 - Urban, rural, land access and well trajectories are all vital to proper relief well design
- Emergency Well Kill and T&A
 - This protects other well assets
 - Typically trees are staged the same on pad sites
 - This places other wells in flow paths
 - Reduced chance of heat or erosion affecting nearby wells

Reactions & Considerations

- Snubbing & Coiled Tubing Interventions
 - If the opportunity is present these resources can be very useful in assisting blowout recovery
 - Large cranes and support structures can become necessary depending on the circumstances
- Well Capping
 - Capping can become difficult with tight well spacing
 - Often it is necessary to cap on the casing which can require excavating
 - Diverting after emergency well head installation is very common





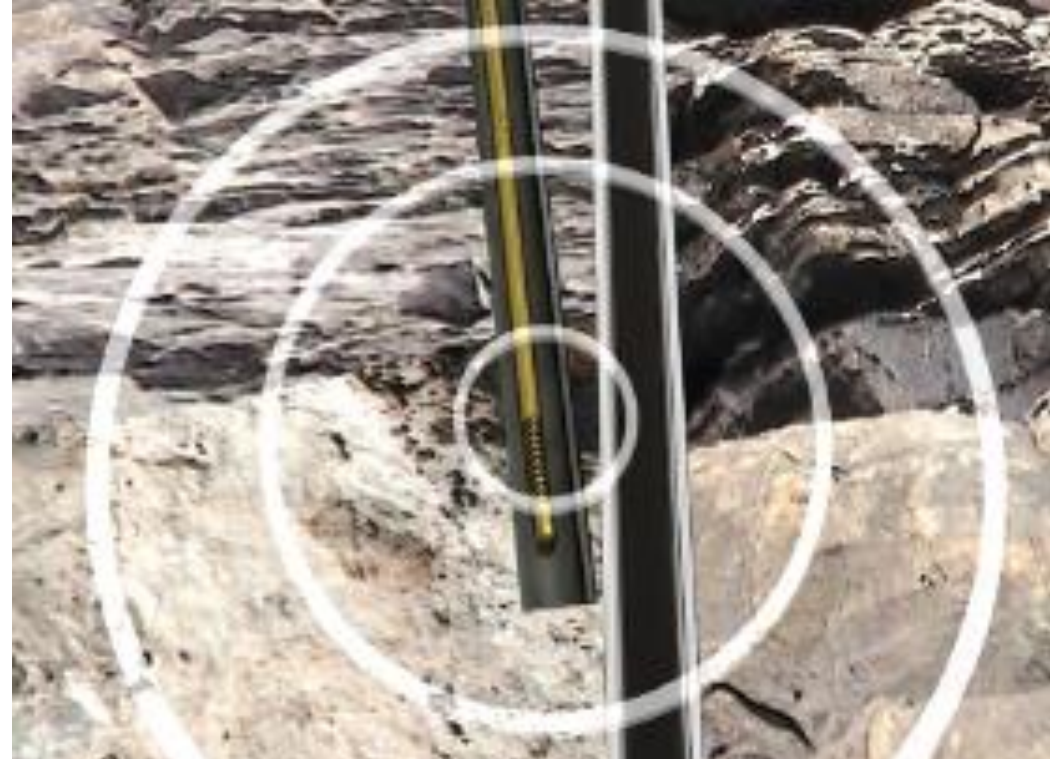
Preparedness Today

Concept of Risk Management

- Development of a Risk Management Program that
 - Identifies the Risks Associated with Control of Well
 - Analyzes the Identified Risks / Consequences
 - Plans to Mitigate / Minimize Those Identified Risks
- The success of a risk management program requires the commitment for long term implementation.

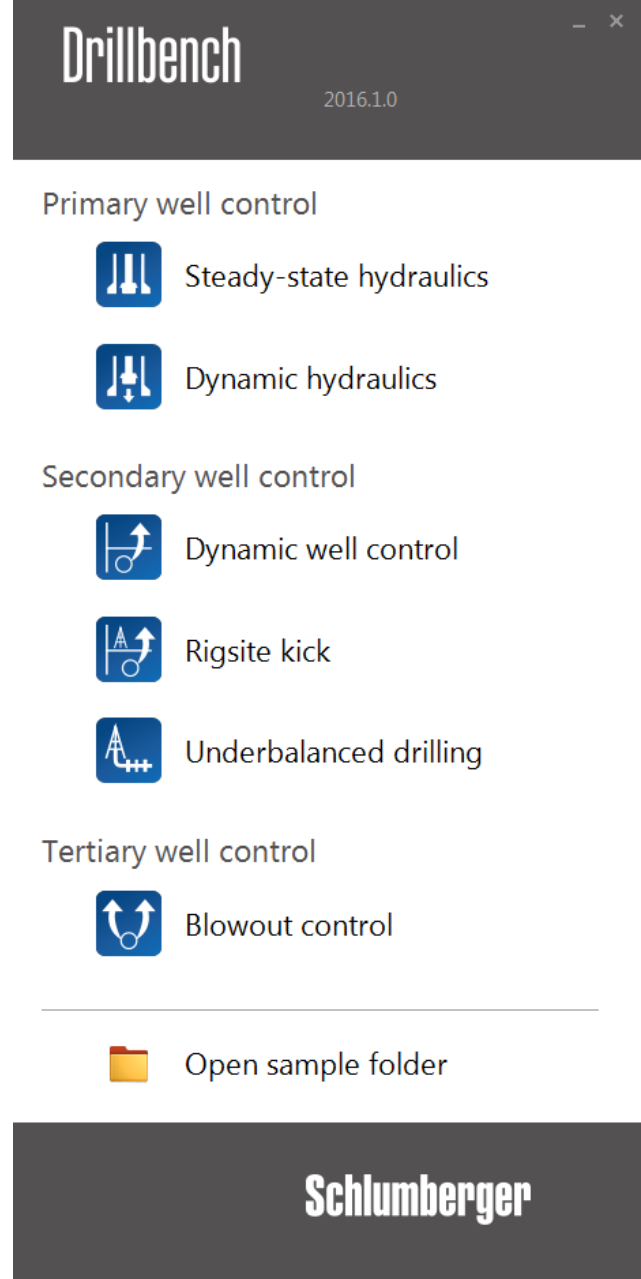
Well Control Planning

- Emergency Response Plan
 - Well-specific
 - Regional
- Casing design support – multiphase kick tolerance analysis
- Relief Well Planning
 - Not planned on every well
- Well Control Training Certification
 - IADC WellSharp and WellCap and IWCF



Kick Modeling

- Two phase time transient model
- Adjustable operating parameters
- More realistic than single bubble models



Well/Equipment Planning

- Evaluate casing design (Kick tolerances, Pressure/Temperature tolerances, Testing)
- Maximum expected pressures, pit volume expansion and surface gas rate
- Kill rate vs choke line friction pressure
- Kill rate vs separator and flare line
- Anticipated wellbore pressure for casing design

Preparedness

Preparedness is a necessity.

- Develop a comprehensive Well Control Emergency Response Plan (WCERP) & train.
- DO NOT HESITATE to activate the Well Control Emergency Response Plan.
- Establish relationship with well control contractor
- Conduct command post table top exercise
- Be proactive. Communicate with the first responders and community

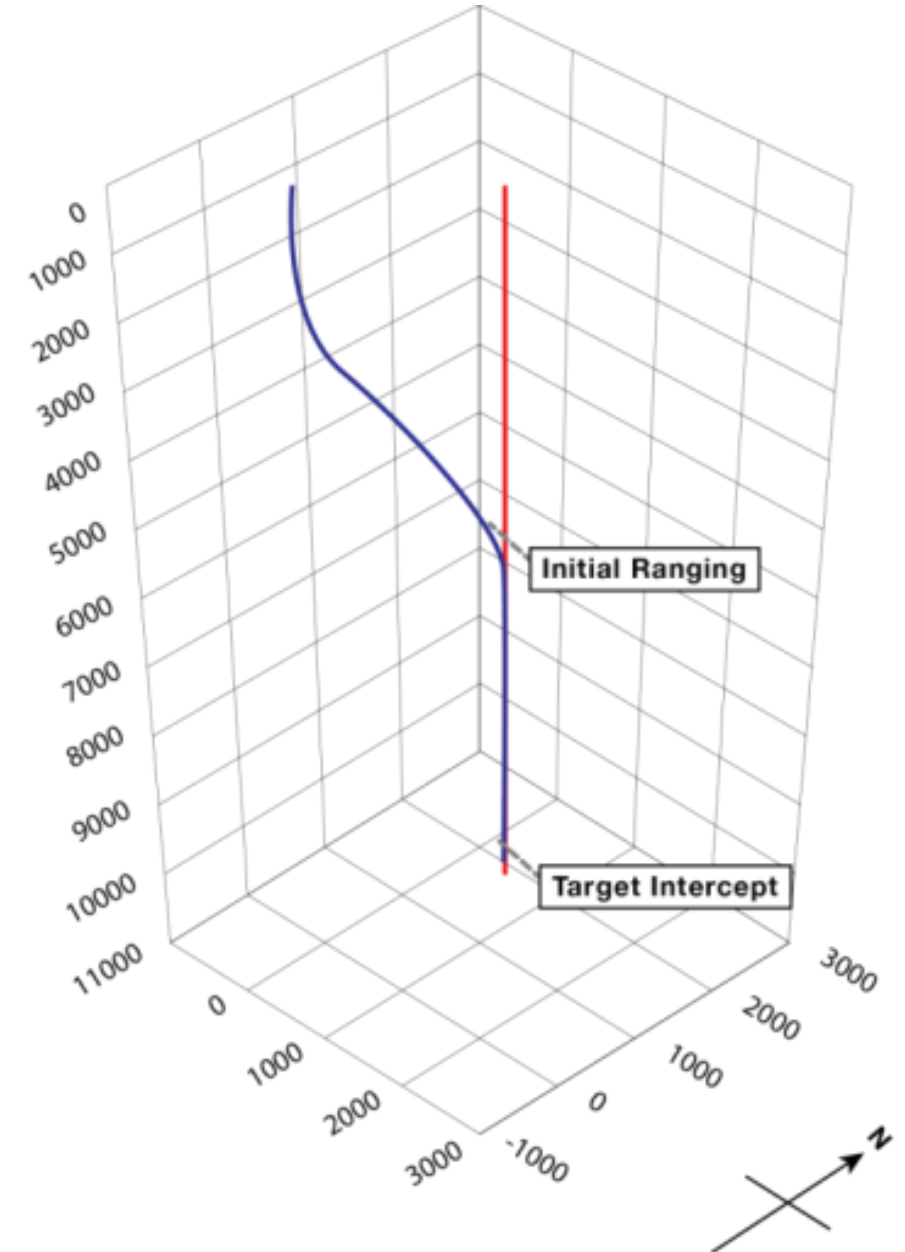


New Tools - Advanced Engineering

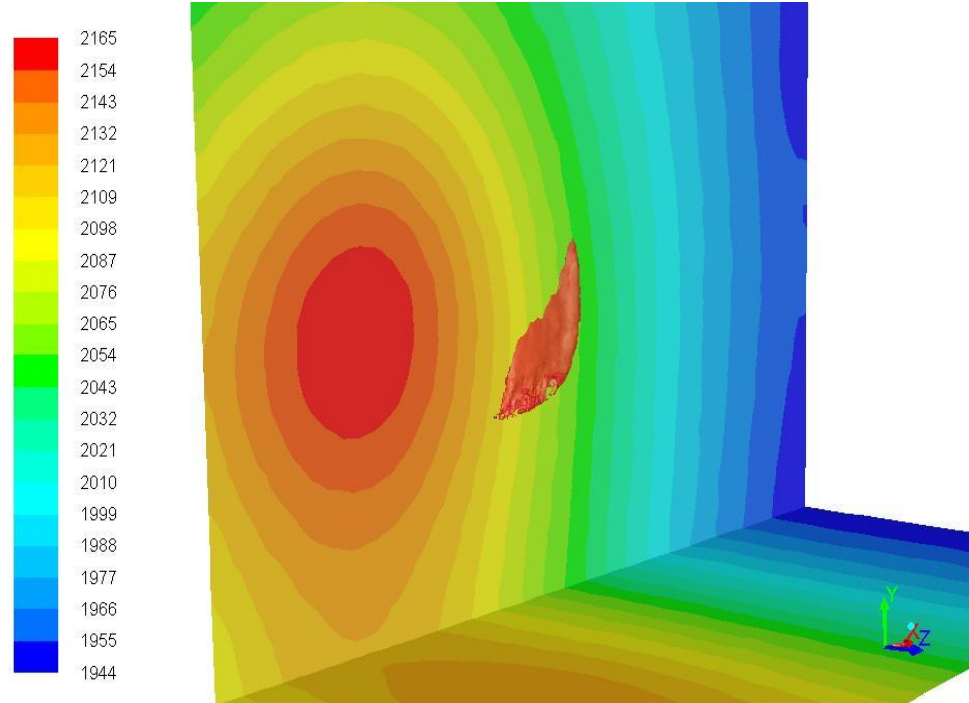
- New technology to protect the operator
 - Relief Well Modeling
 - Dispersion Exclusion Zone ID
 - Subsea Dispersion Zone 2
 - Advanced Dispersion Zone 2
 - Capping Stack Landing Analysis
 - Erosion Modeling

Advanced Engineering – Pre-Drill Relief Well Modeling

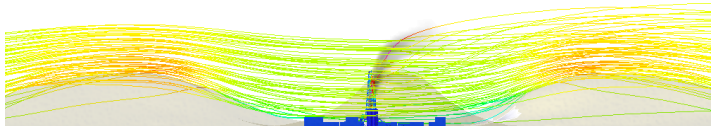
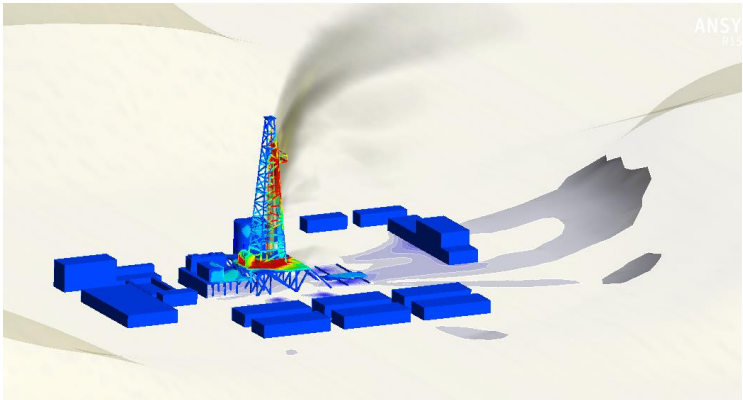
- New technology in relief well planning and modeling make it one of the primary solutions for subsea well control events.
- Pre-drill modeling can confirm the ability to conduct well kill operations through one or more relief wells, etc.



Radiant heat



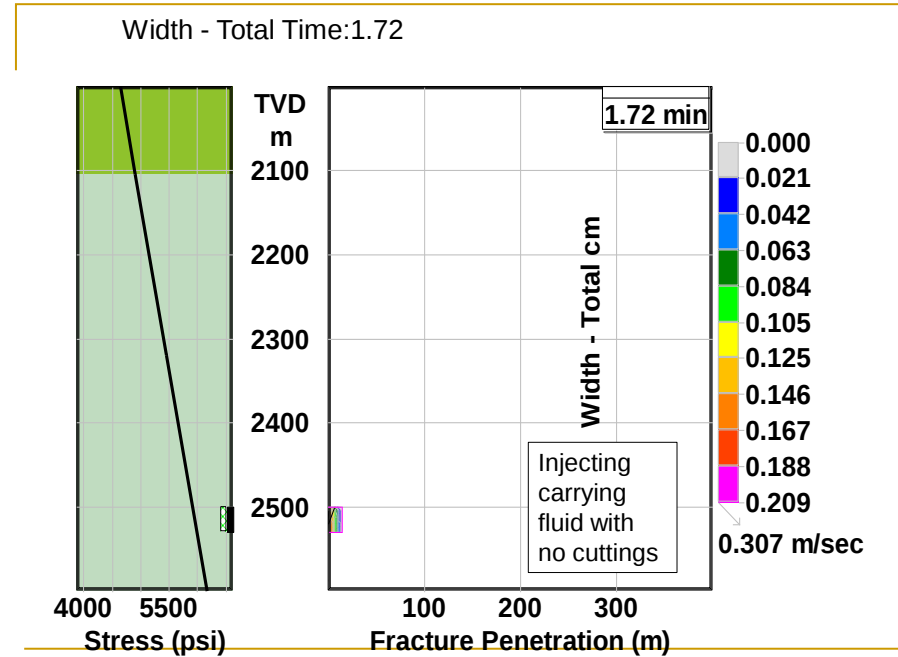
Fire & radiant heat



FIRE EFFECTS ON PERSONNEL & EQUIPMENT

Technology Advancements

- Broaching analysis





Training – Preparing Personnel



First line of defense

The drilling rig crew and other personnel on location are the first line of defense in preventing a well control incident.

They must be trained and prepared.

Current Industry Training



- IADC – WellSharp and WellCap Certification
 - Predominantly Domestic US

- IWCF – Certification
 - Predominately International
 - More In-depth and complex
 - Participant have basic math fundamentals

Rigsite Training

- Well Specific Readiness Training
 - Classroom training on your rigsite
 - Critical components
- Rig Site Kick drills
 - Crew readiness evaluation
 - Competency enhancement
 - Review of response skills



BE PREPARED !

- Protect your employees
- Protect the public
- Protect the environment

**A QUICK RESPONSE
IS MOST IMPORTANT**



A large, stylized graphic of a flame or fire, rendered in a lighter shade of blue than the background. It is positioned on the left side of the slide, with its base near the bottom left corner and its top reaching towards the top left. The flame has several distinct, upward-pointing tongues.

THANK YOU

ANY QUESTIONS?