Well Control Considerations During a CO_2 Blowout

SPE Virtual Seminar

Feb 2022

EXPERIENCE.
THE WILD WELL DIFFERENCE

Wild Well Control

Our Story

- Founded by Joe Bowden, Sr., in 1975
- World Headquarters in Houston
- Acquired in 2001 by Superior Energy Services
- ISO 9001, 14001 & OHSAS 18001 certified

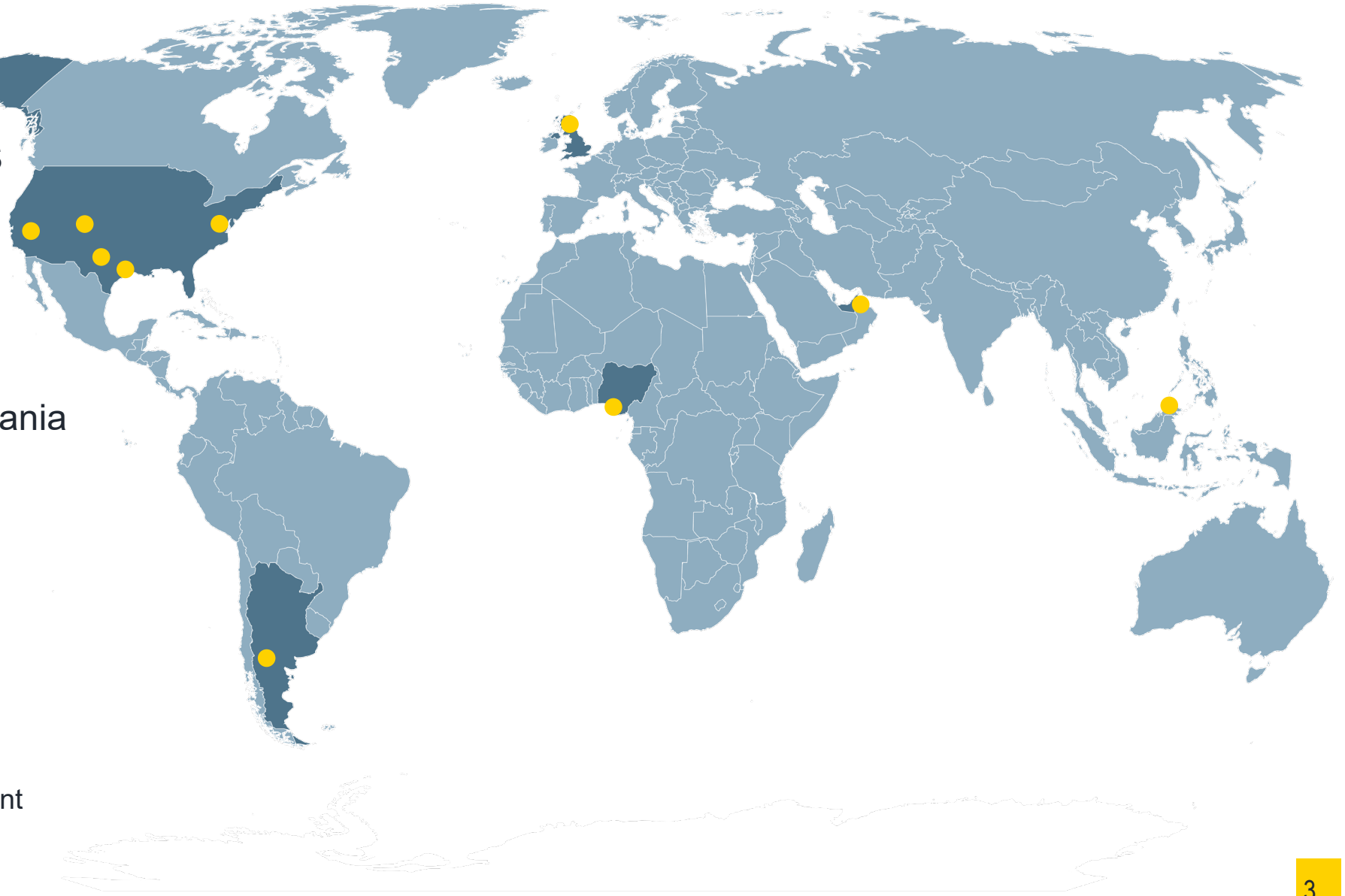
WILD WELL CONTROL

Response Resources

Staged around the world

EQUIPMENT OPERATIONS

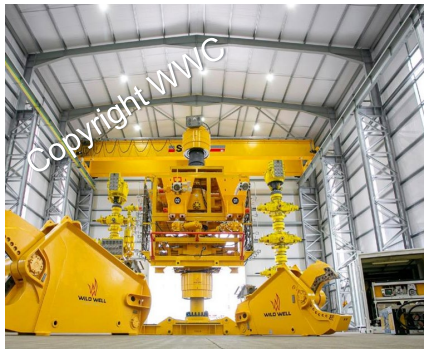
- Houston, Texas
- Odessa, Texas
- Greeley, Colorado
- Bakersfield, California
- Roaring Branch, Pennsylvania
- Aberdeen, Scotland*
- Singapore*
- Port Harcourt, Nigeria
- Dubai, UAE
- Neuquén, Argentina



*includes WellCONTAINED equipment

Our Core Services

Supporting your operational needs



WELL CONTROL

- Blowout & Well Control Response
- Pressure Control
- WellCONTAINED

ENGINEERING

- Dynamic Kill Modeling
- Kick Modeling
- Broaching Modeling/Analysis
- Bullheading Modeling
- Relief Well Operations
- Computational Fluid Dynamics
- Structural Analysis
- Mechanical & Structural Design
- Dispersion Modeling

UNCONVENTIONAL INTERVENTION

- Hot Tapping
- Valve Drilling
- Freezing
- Well Integrity

WELL CONTROL TRAINING

- IADC Certification
- WellSharp
- WellSharp Live
- E-Learning

WellCONTAINED PREVENTION & PREPAREDNESS

- Subsea Capping
- Emergency Response Plans
- Emergency Response Training, Drills & Exercises

Part 1

CCUS & Blowouts

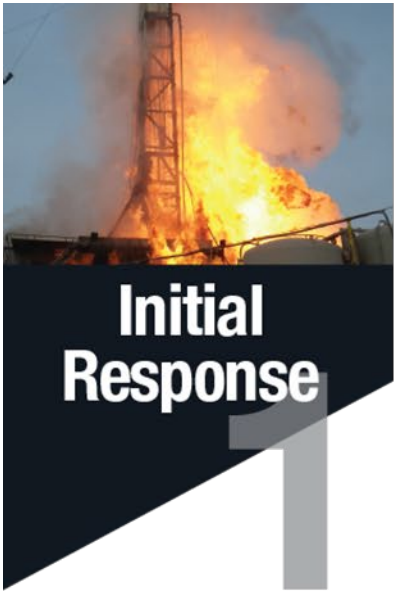
When could a CO_2 blowout occur?

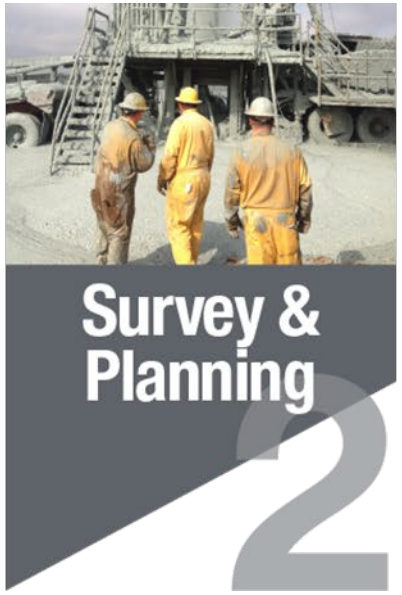
- Risks lower than for hydrocarbons?
- But blowouts could occur
  - During workover
  - During a sidetrack
  - Failure of an orphan well
- So how do you respond to a CO_2 blowout?

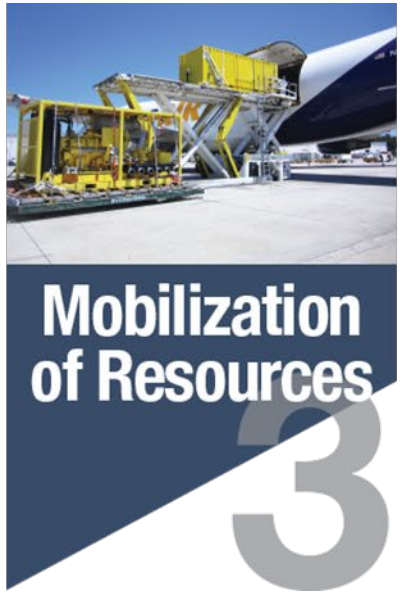
Part 2

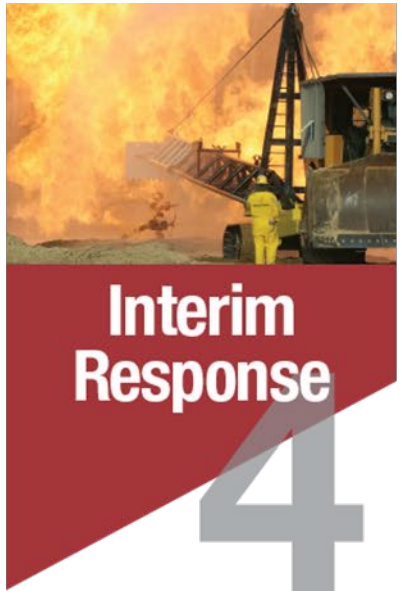
Response Actions

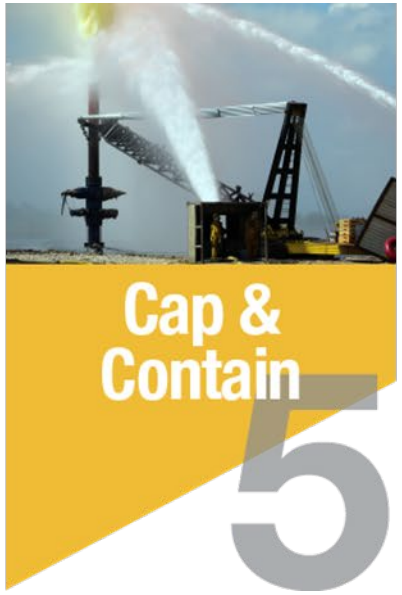
Same basic approach to any blowout





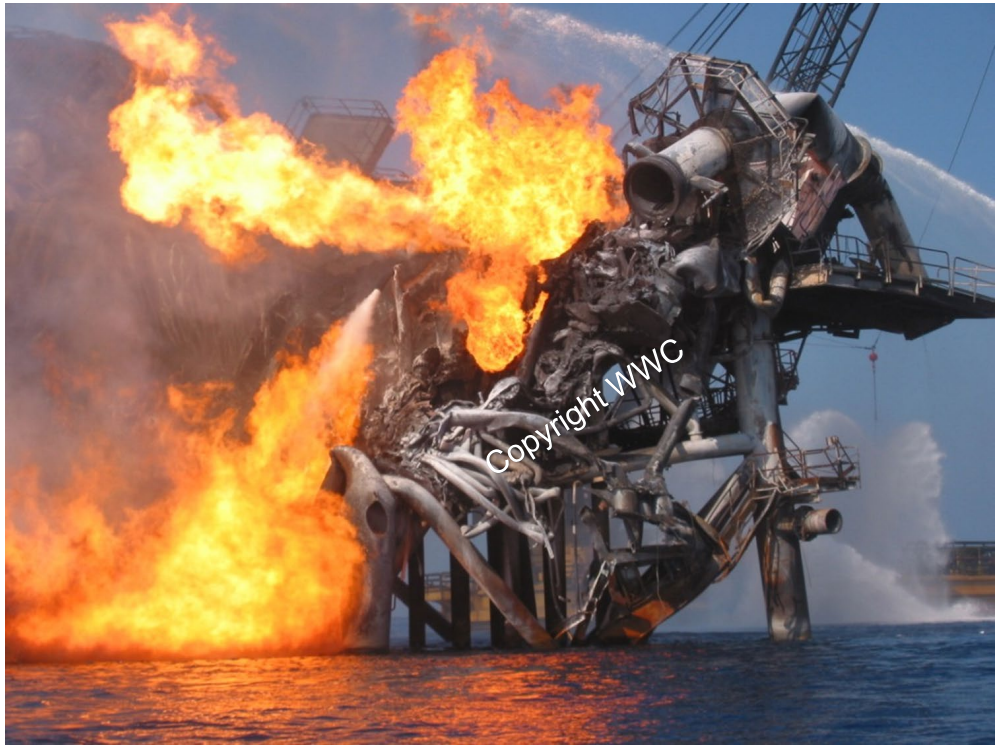




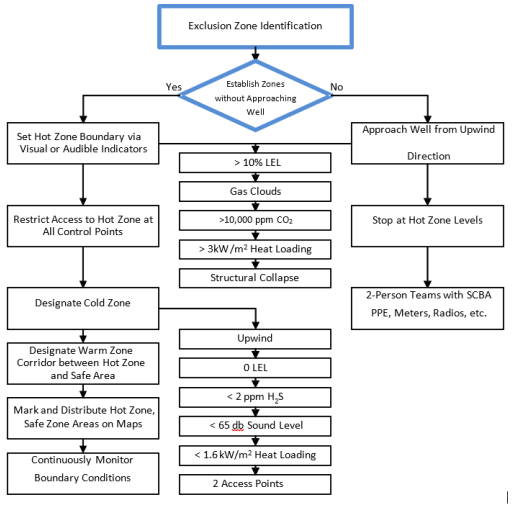


Phase 1 – Initial Response and Mobilization

Phase 2 – Assessment of Well Conditions



Phase 3 – Staging Equipment

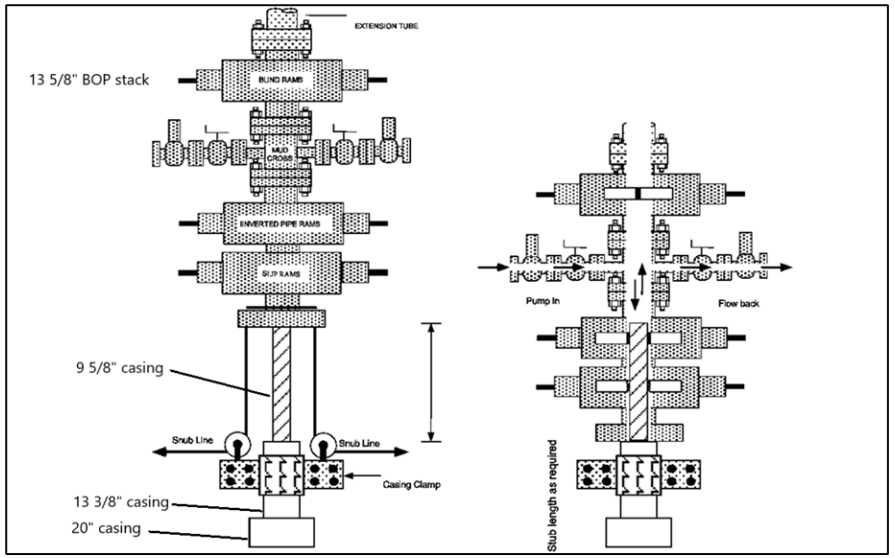


- Effective site control essential
  - Establish hazard zones
  - Personnel accounting
- Ground Prep?
- Offshore – barge?
- Capping stack deployment vessel
- Relief well rig & support vessel requirements

Phase 4 – Debris Removal & Wellhead Access

Phase 5 – Well Capping

Phase 5 – Well Capping - Challenges

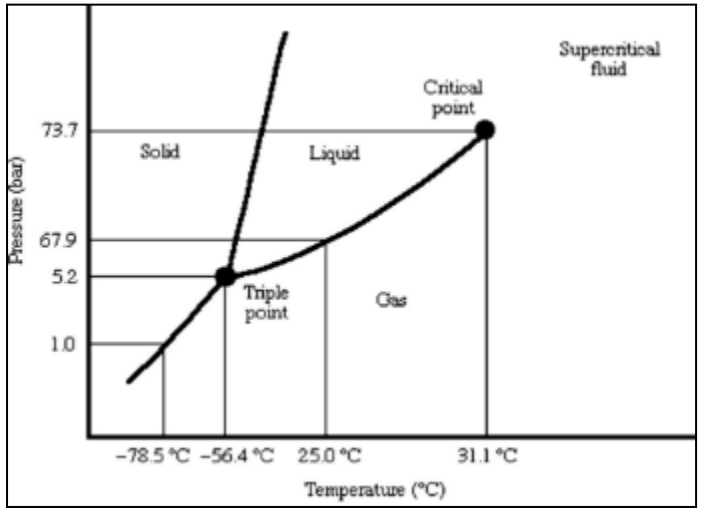


Phase 6 – Post Capping Plans – Kill & P&A

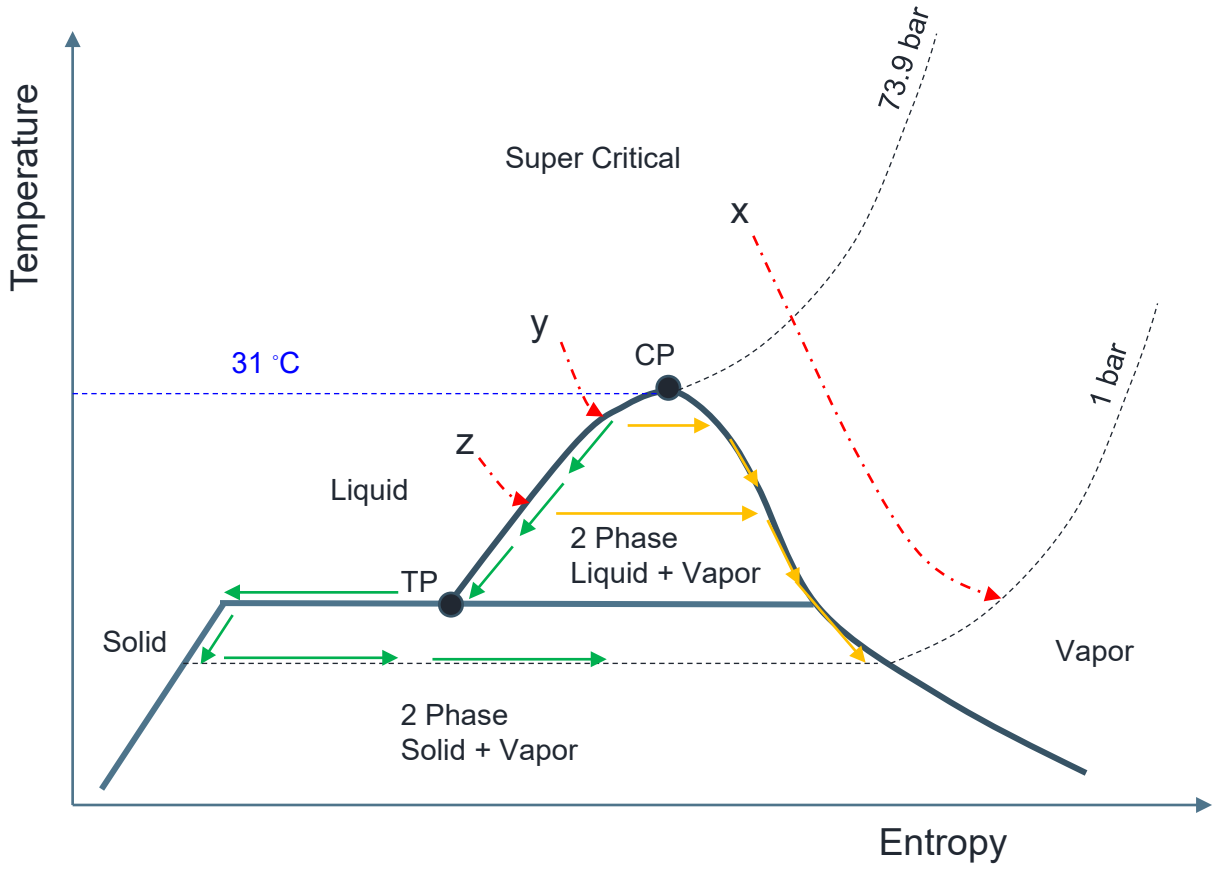
Part 3

Well Flow Modeling & Other Simulation

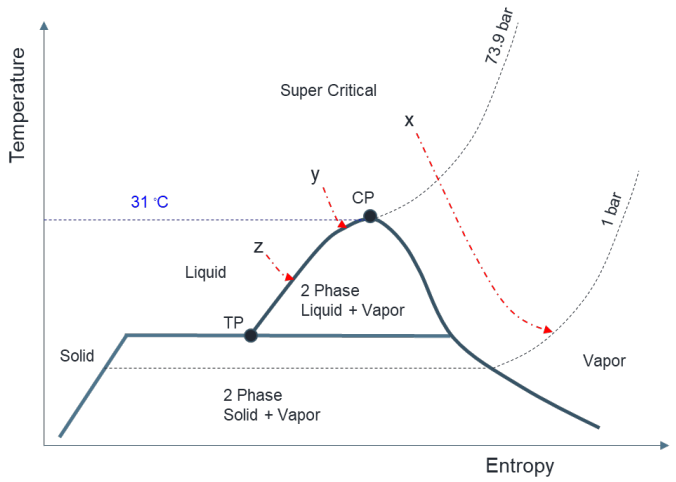
Thermodynamics of CO_2

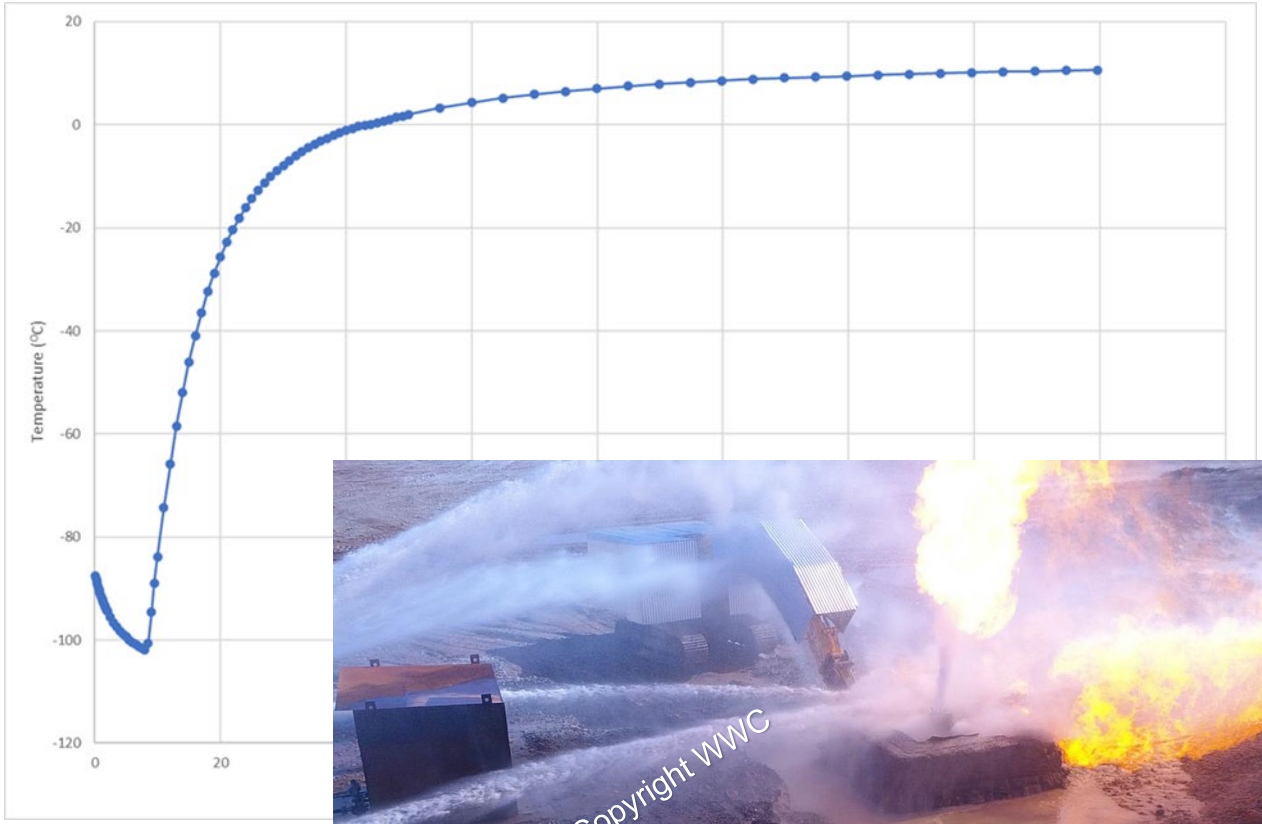


At atmospheric pressure CO_2 can only exist as a solid or a vapor

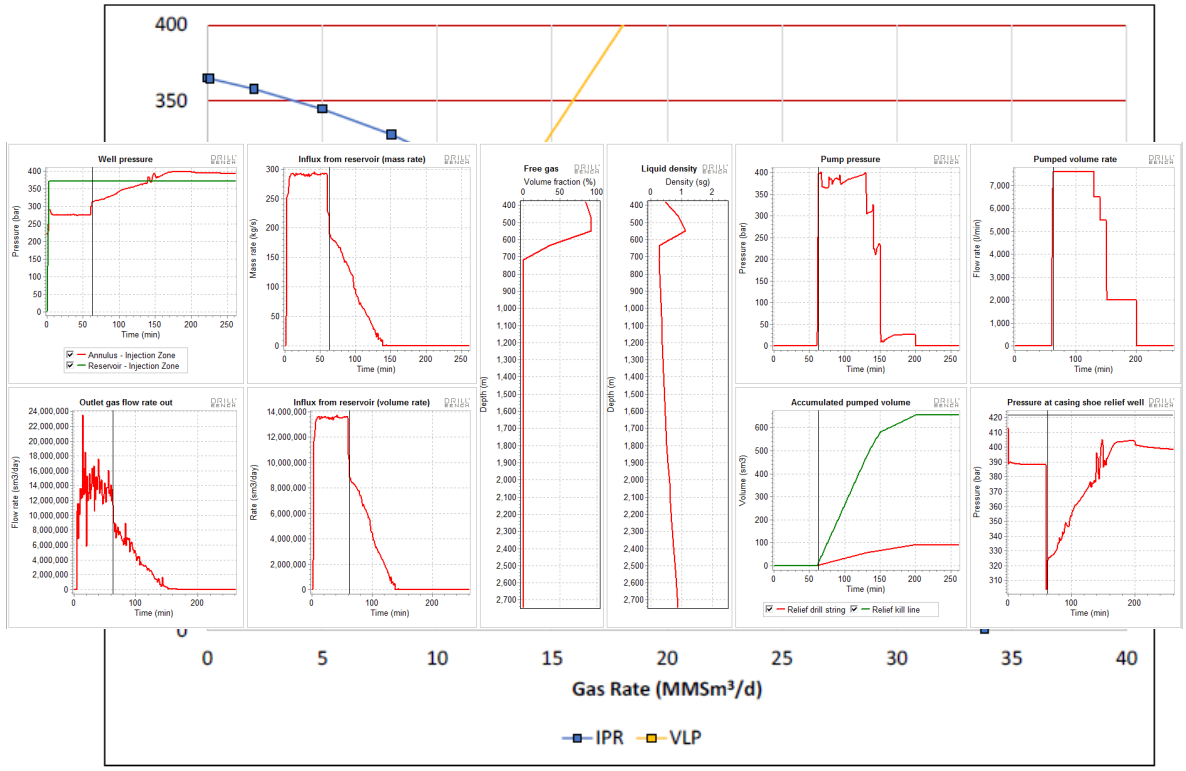


Thermodynamics of CO_2





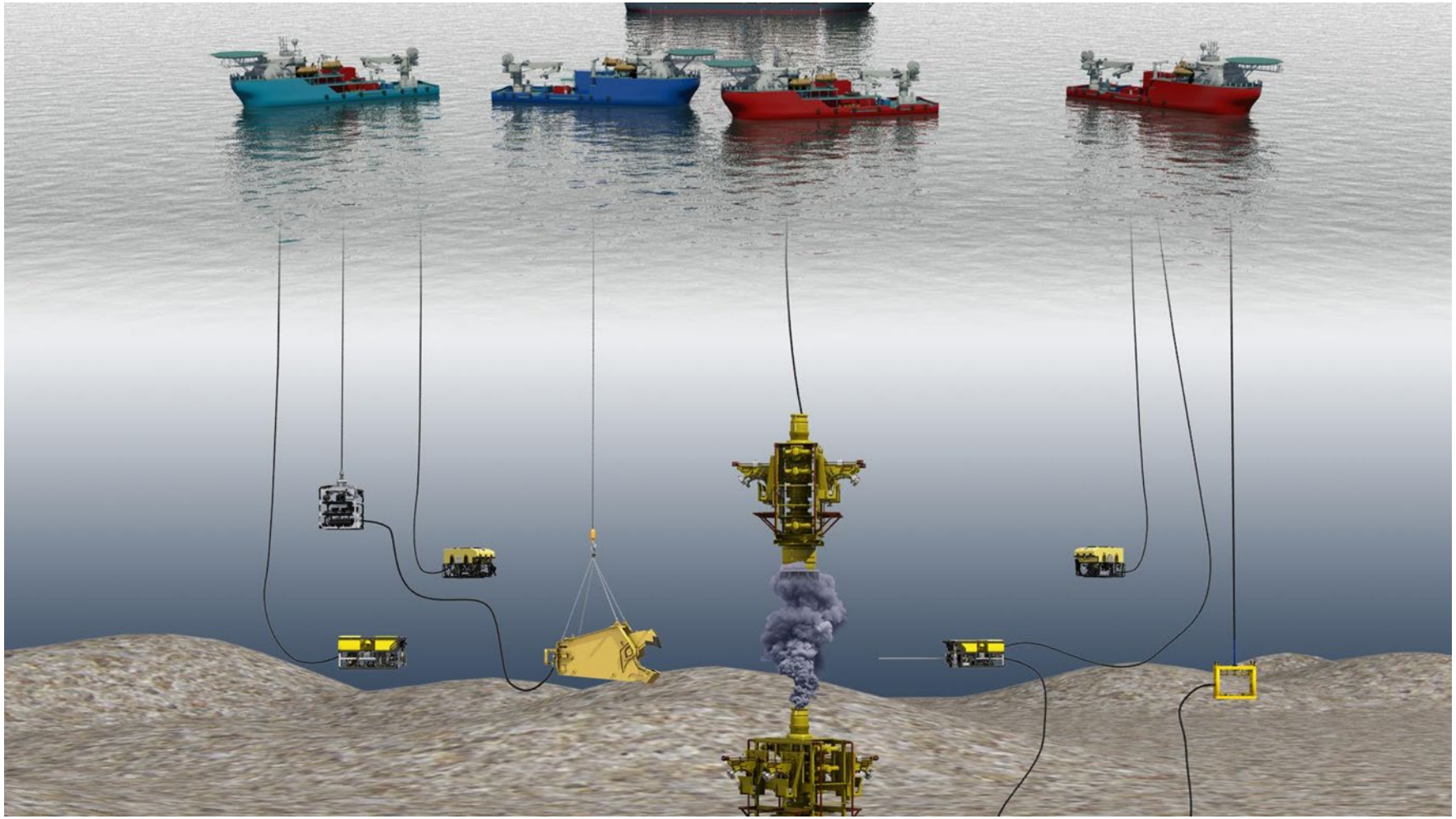
Thermodynamics of CO_2 – Blow Out Rate Prediction



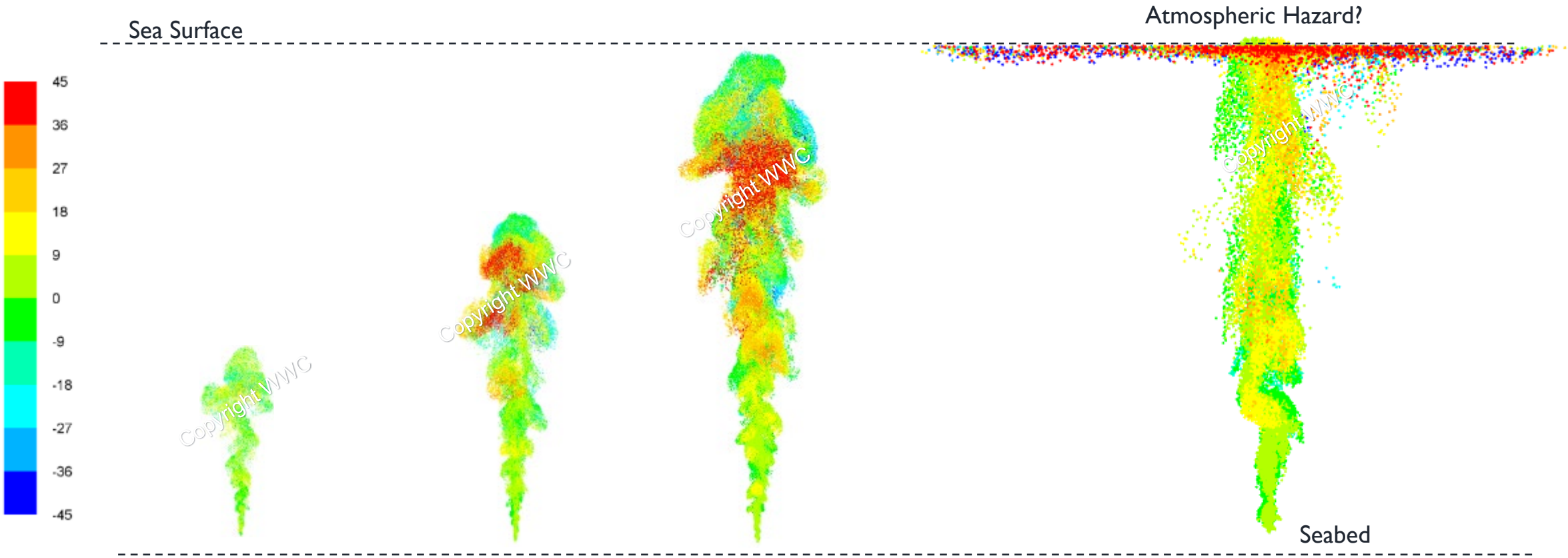
- PROSPER
- Blowout rate found from comparing IPR and VLP
- Specific PVT (CO_2 99%+) & EoS
- Dynamic kill – use DrillBench again with appropriate CO_2 modifications

Hazard Assessments for Surface Response

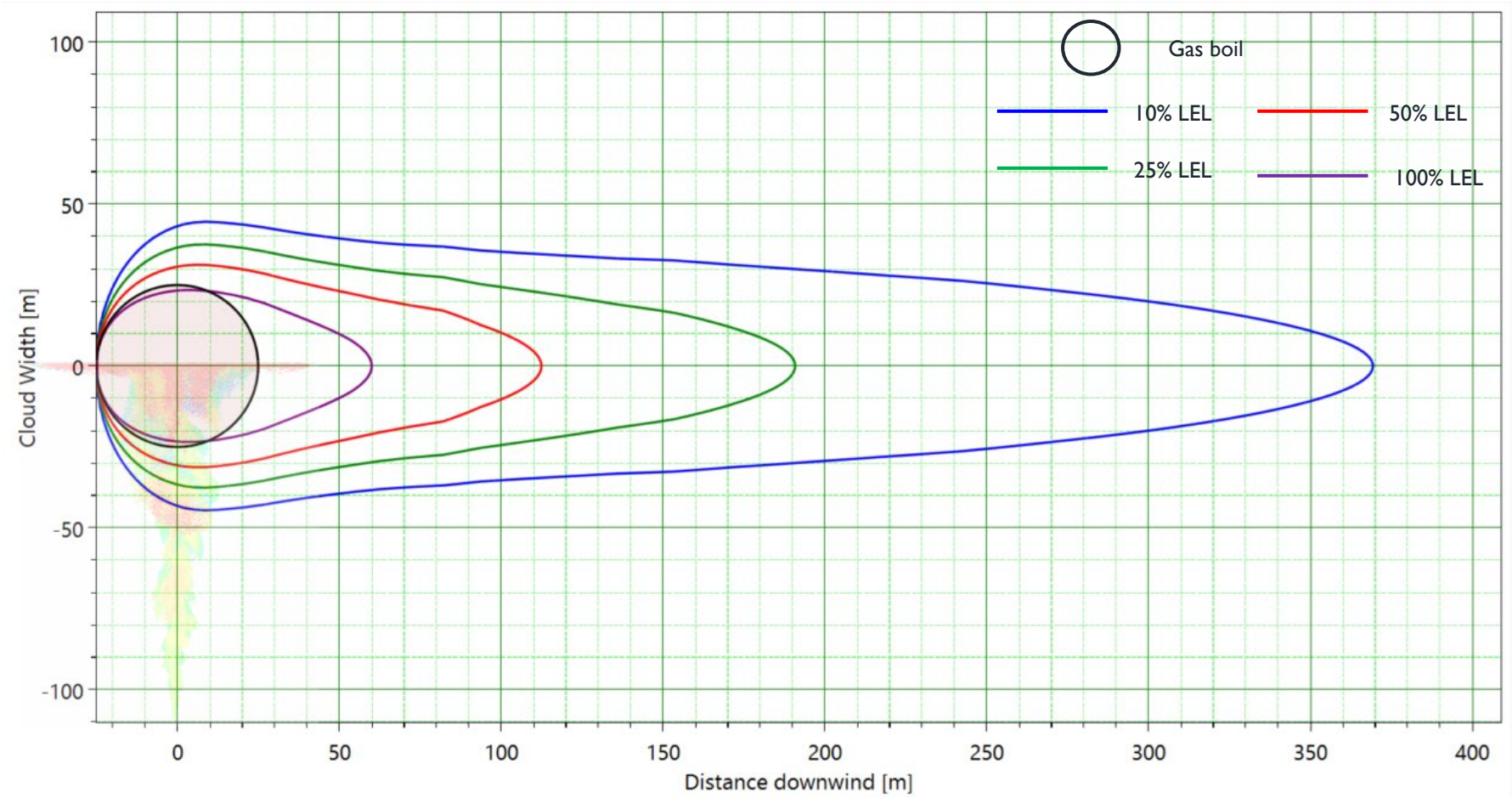
Hazard Assessments for Surface Response



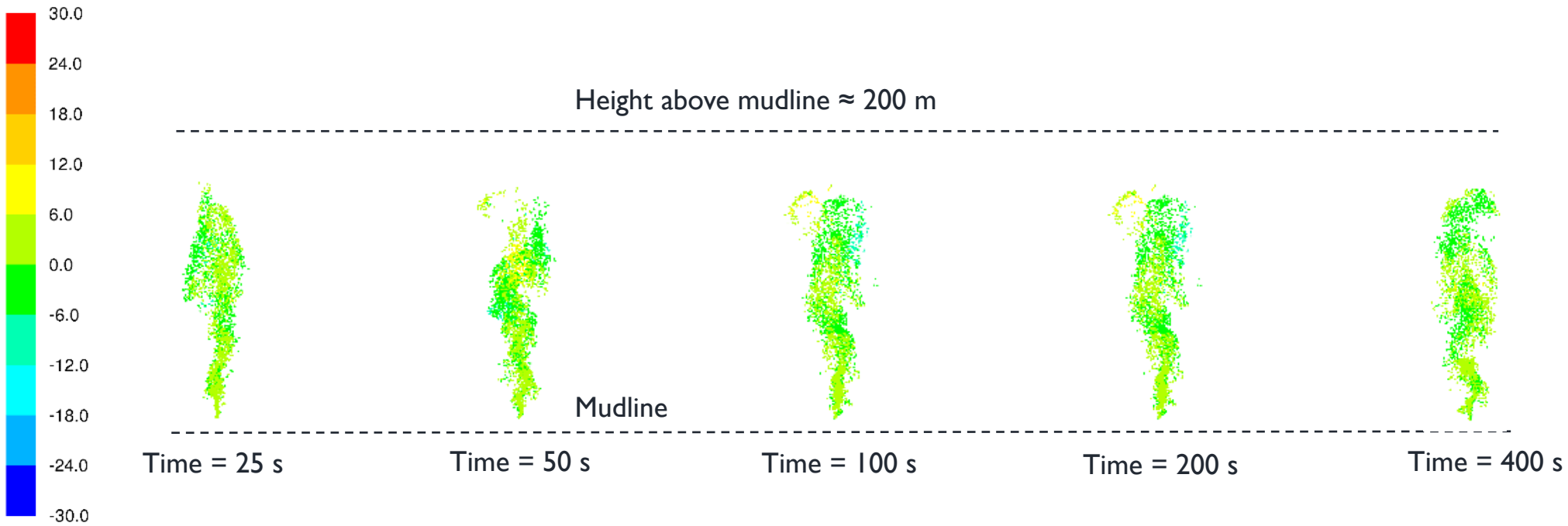
Subsea releases – Natural Gas



Subsea releases – Natural Gas

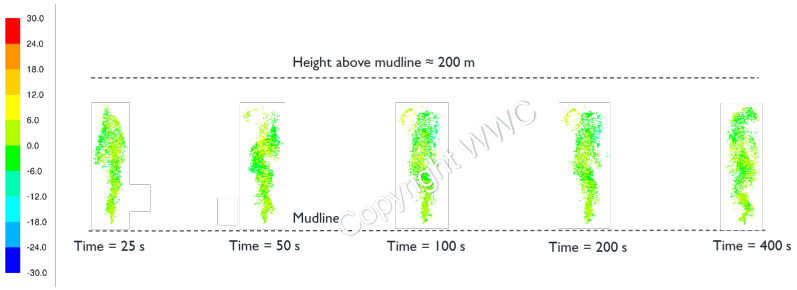


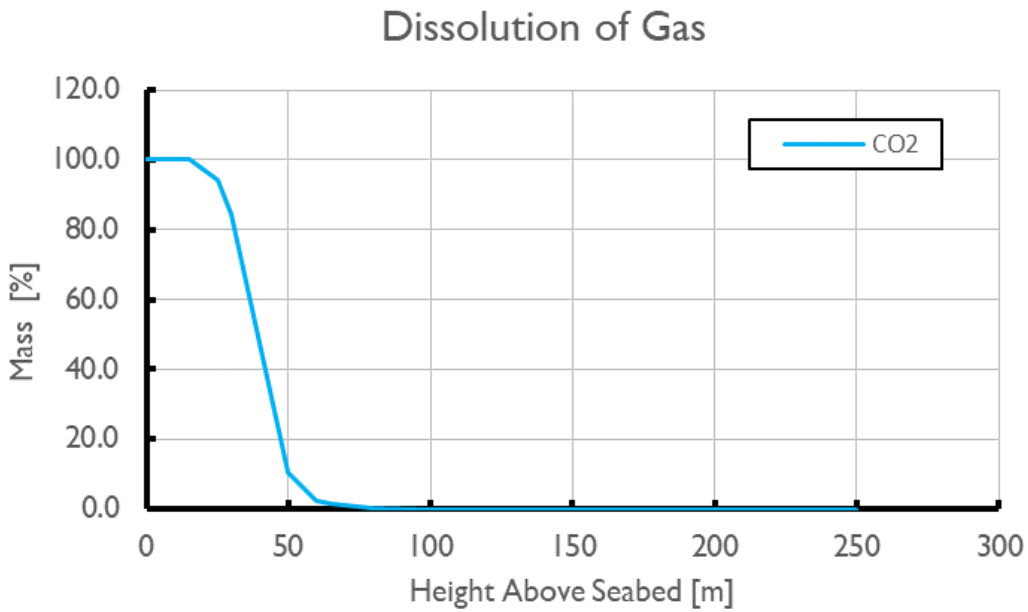
Subsea releases – CO_2



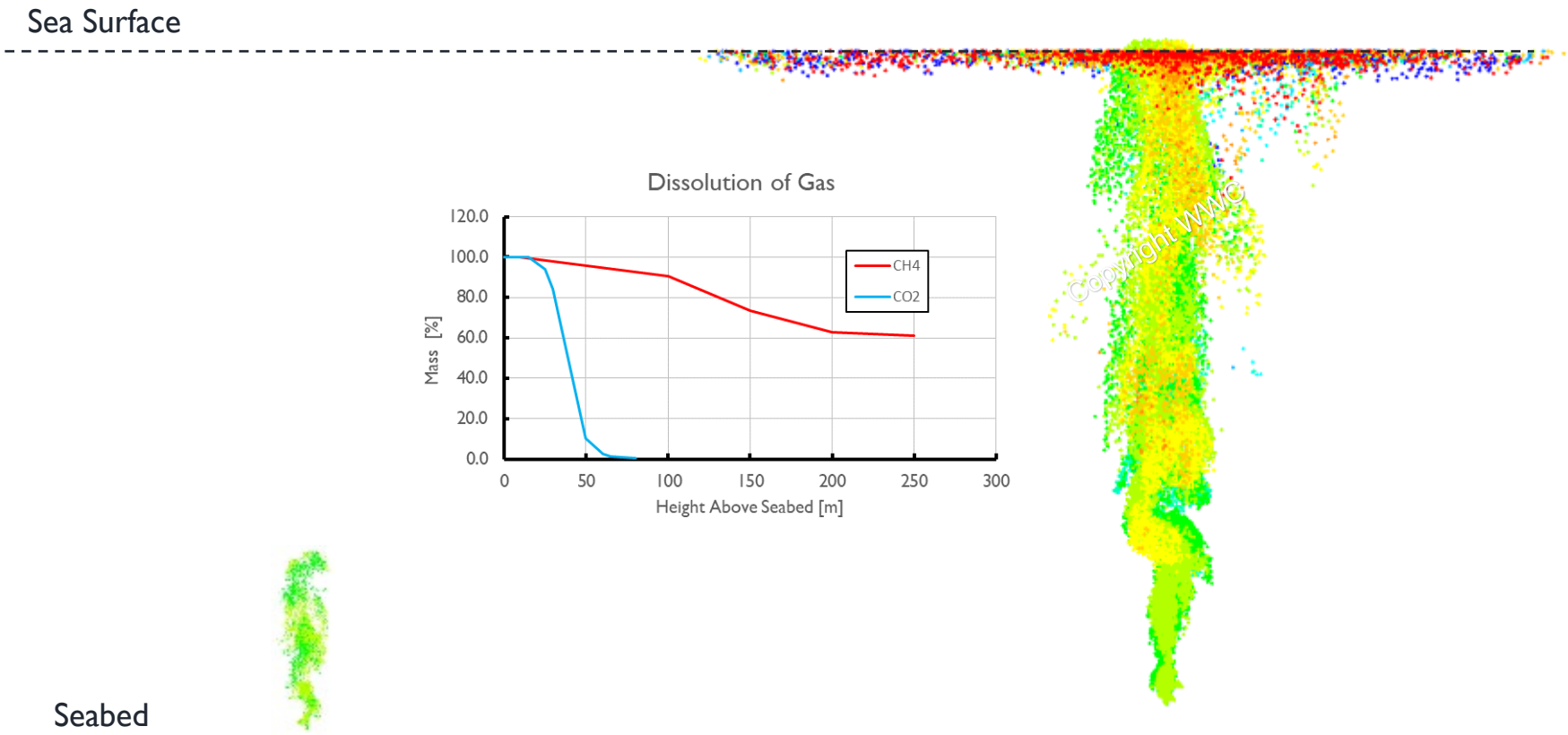
Contour coloured by distance from plume axis towards viewer (blue = -30 m, red = 30 m)

Subsea releases – CO_2





Subsea releases – CO2 v Methane



Contour coloured by distance from plume axis towards viewer (blue = -30 m, red = 30 m)

Can we land a capping stack

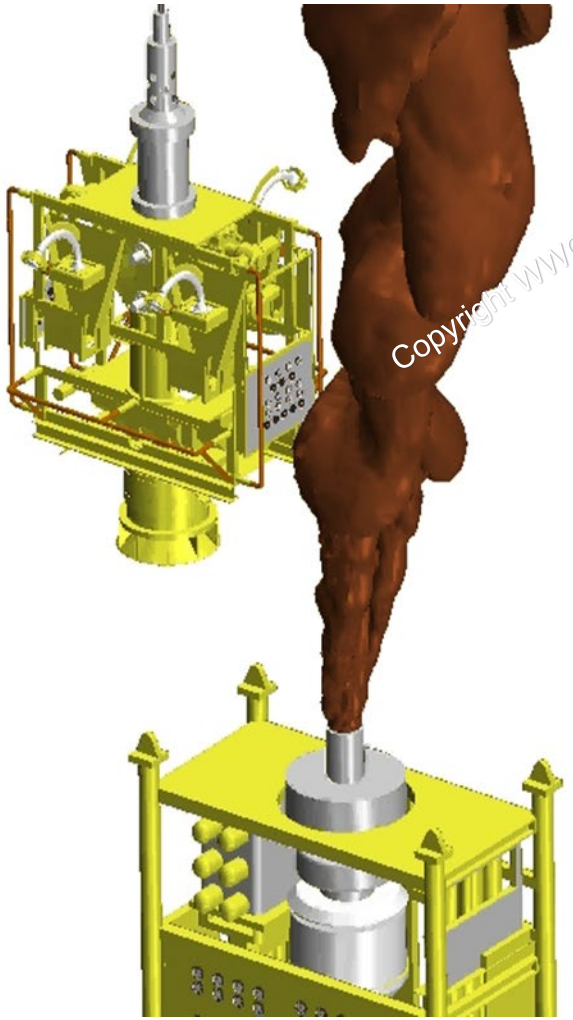
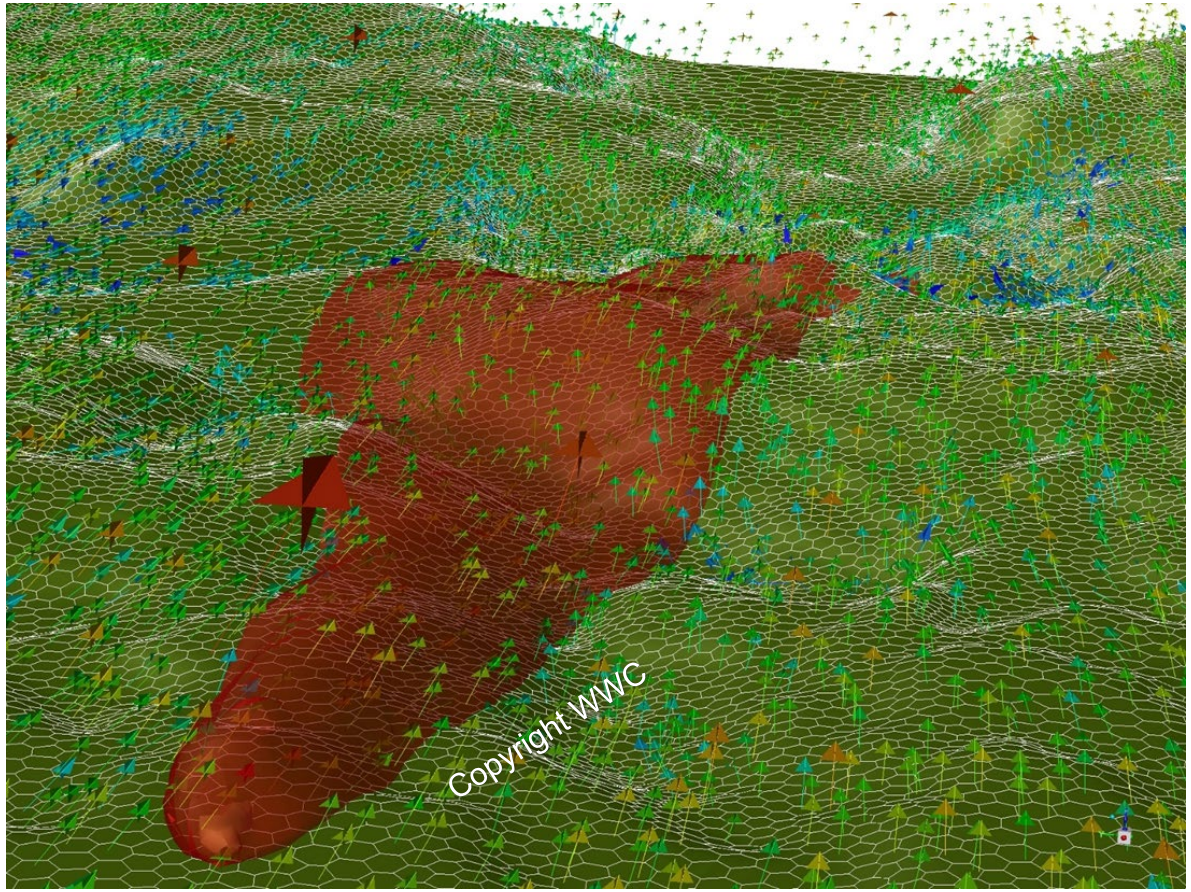


Image courtesy of SURE JIP

Dense Gas Dispersion

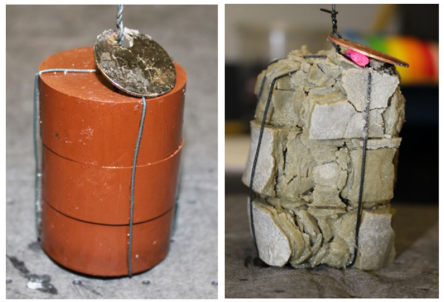


Part 4

Other CO_2 Considerations

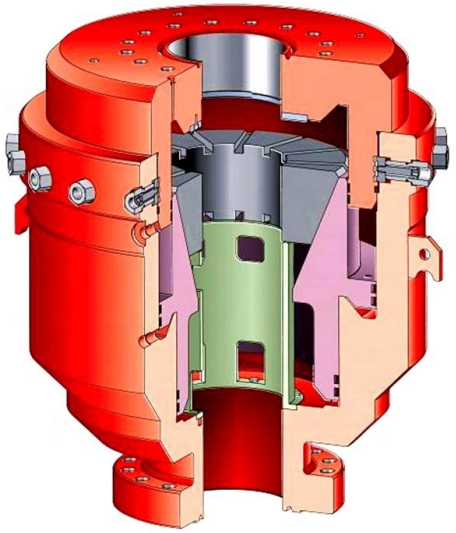
Options for CCUS

- Option 1: Existing Field Using P&A'd wells
  - Could include land, inland water, and continental shelf
  - P&A's designed for depleted field pressure
  - As field pressures increase, older P&A's could prove problematic from a well control aspect
    - CO_2 is very corrosive to cement and tubulars, so wells that are P&A'd successfully could eventually degrade and prove problematic from a well control aspect – longer life need
    - Never sure what's down there – P&A costs are hard to predict



- Option 2: Existing Field Using new wells
  - P&A's designed for depleted field pressure
  - As field pressures increase, older P&A's could prove problematic from a well control aspect
    - CO_2 is very corrosive to cement and tubulars, so wells that are P&A'd successfully could eventually degrade and prove problematic from a well control aspect
- Option 3: New Field with new wells
  - Wells will be required to be designed to different standards (in USA – similar elsewhere) using CRA etc – with longer liability

Well Control Equipment



Wrap Up

Take Away's

- CO_2 blowouts – need an emergency response plan
- System response needs to be properly risk assessed
- Continue to validate simulations
- Offshore - water depth is your friend
- New CCUS wells & reservoirs versus re-use needs properly considered

Any Questions?

Visit us at www.wildwell.com

Email: agill@wildwell.com