From: John Wright
Sent: Fri Apr 30 19:35:38 2010
To: Corser, Kent
Subject: RE: John Wright - contact info.
Importance: Normal
Attachments: image001.jpg; image004.jpg; WFD_3_Case_Histories.pdf; WFD_2_OWK.pdf; WFD_1_History_Org_Serv.pdf; drillbench5.pdf

Some information about Well Flow and the Olga-Well-Kill software and drillbench we will be using.

http://www.addenergy.no/drilling-production/category352.html

John Wright
Sr. Vice President Technology
Boots & Coots
7908 N. Sam Houston Pkwy W
5th Floor
Houston, Texas 77064
Ph: +1-281-931-8884
Cell: +1-210-669-8425
email: jwright@boots-coots.com

cid:614134421@11022009-2C36

From: Corser, Kent [mailto:Kent.Corser@bp.com]
Sent: Friday, April 30, 2010 2:04 PM
To: Wright, John W (Alert DC)
Cc: John Wright; rtoskarsen@jwco.com; Ole B. Rygg; Morten Haug Emilsen; Lucari, James L; Kimberley.Teweleit@bp.com; Michael.Daneker@aporter.com; Goodman, Wendy; Corser, Kent
Subject: RE: John Wright - contact info.

Thanks John. I have copied a few people on this note. James Lucari & Michael Daneker are the lawyers involved. Wendy Goodman is our business support.

Kent Corser
Drilling Engineering Manager NAG
BP America Inc
510 Westlake Park Blvd Room - 2.332A
Houston Texas 77079
Office- 281-366-2142

Cell - 281-433-0093
Home - 281-578-3224

From: John Wright [mailto:jwright@jwco.com]
Sent: Friday, April 30, 2010 1:55 PM
To: Corser, Kent
Cc: 'John Wright'; rtoskarsen@jwco.com; 'Ole B. Rygg'; 'Morten Haug Emilsen'
Subject: John Wright
Kent,

My contact details are below. Dr. Ray Oskarsen and myself will be at your office in the morning at 09:00. Either Morten Emilsen or Dr. Ole Rygg will be coming from Oslo tomorrow. They will let me know details once they get flights booked, but should get late tomorrow or Sunday.

Regards,

John Wright
Sr. Vice President Technology
Boots & Coots
7908 N. Sam Houston Pkwy W
5th Floor
Houston, Texas 77064
Ph: +1-281-931-8884
Cell: +1-210-669-8425
email: jwright@boots-coots.com

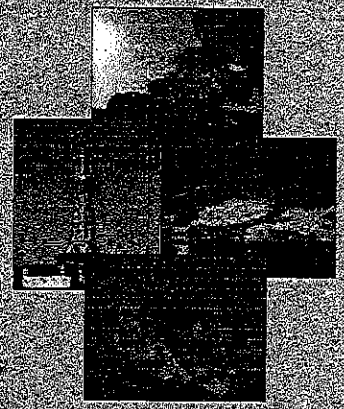
cid:614134421@11022009-2C36

Well Flow Dynamics as
Drilling and Production Engineering

Well Flow Dynamics AS – Part 3
Blowout contingency – Case Histories

Dr. Ole B. Rygg
President, Well Flow Dynamics AS

Houston, September 27, 2006



www.wellflow.com

Contingency Plans

Well Flow Dynamics conducts evaluations including blowout and kill simulations for all major oil companies all over the world.

Blowout Contingency Plan - Hydraulics

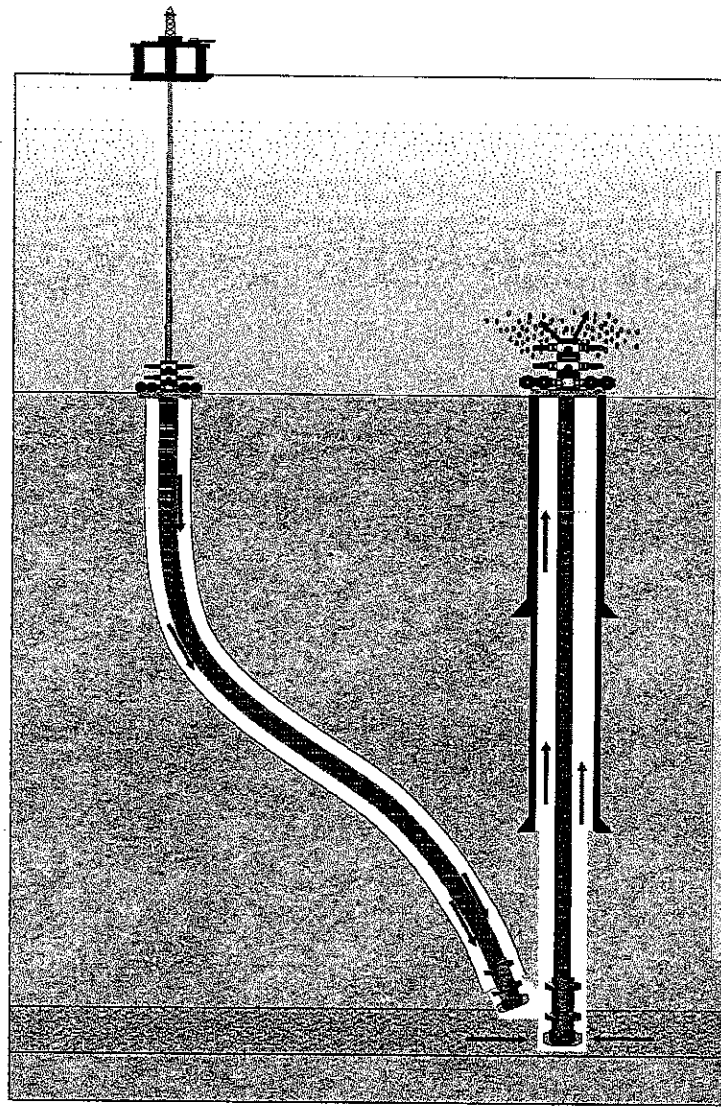
- Define worst case scenarios based on the drilling and development plan
- Calculate maximum blowout rates
- Evaluate potential kill options
- Calculate required kill rates and volumes
- Identify and check relief well location
- Identify drilling rigs for relief well drilling
- Investigate the practicality of the chosen intervention
- Investigate blowout probability and blowout frequencies for the area and the planned operations

Blowout Scenarios

- Blowout through the drillpipe
- Blowout through annulus
  - to seabed
  - to surface
- Blowout through open hole
- Blowout through the production tubing
- Underground flow

Direct relief well intersect method

- Dependent on a ranging target, such as a casing or tubing
- The preferable and most used option for relief well intervention
- Dynamic kill -> hydrostatic balance
- At stable conditions, cement can be pumped for final static control



Dynamic Kill Method

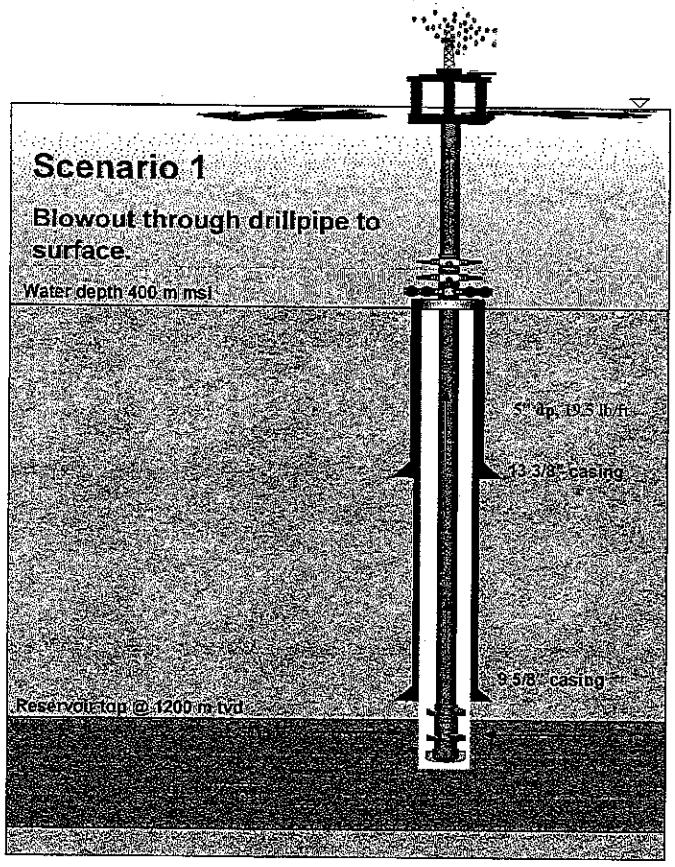
Volumetric kill with the following added:

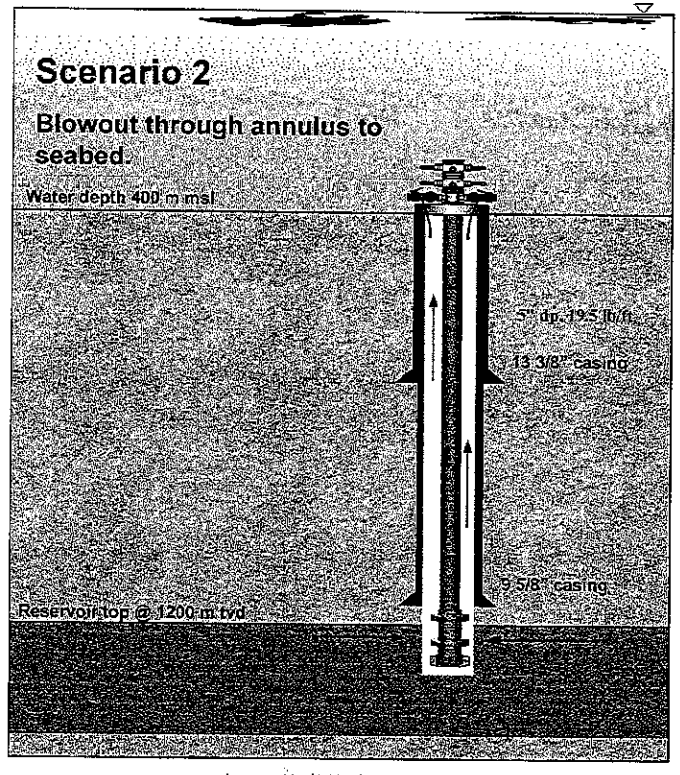
- **Wall frictional pressure**
- **Restrictions / applied back pressure**
- **Time transient wellbore fluid changes**
- **Time / rate dependency of reservoir build-up**

Case Study

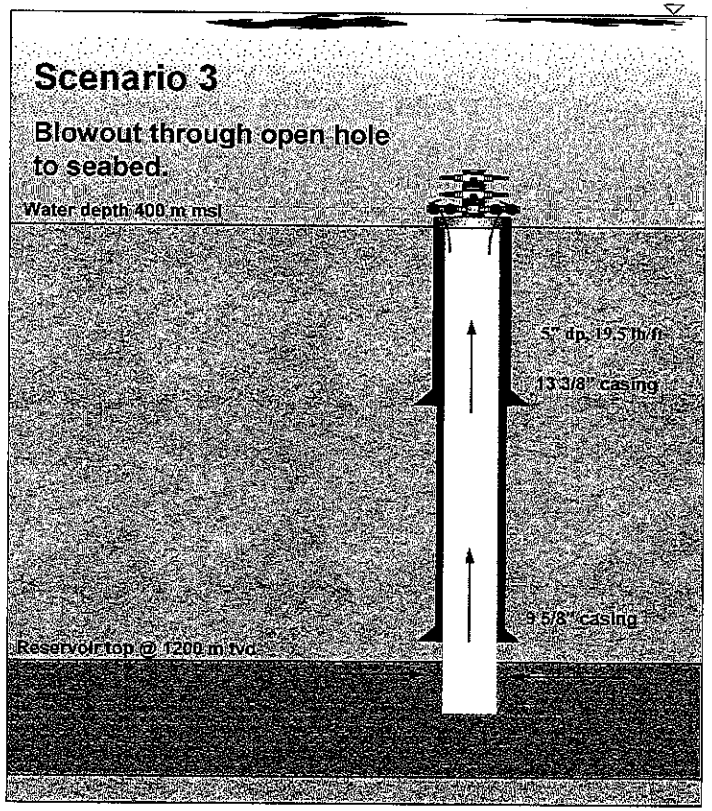
Blowout contingency for an exploration well in an environmentally sensitive area

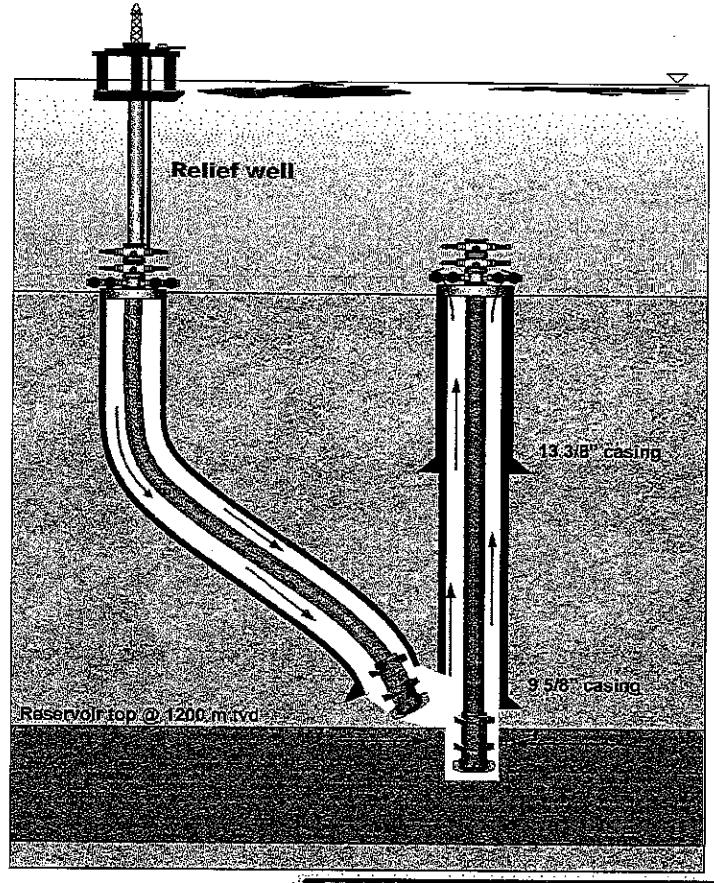
Blowout contingency - Worst Case Scenarios



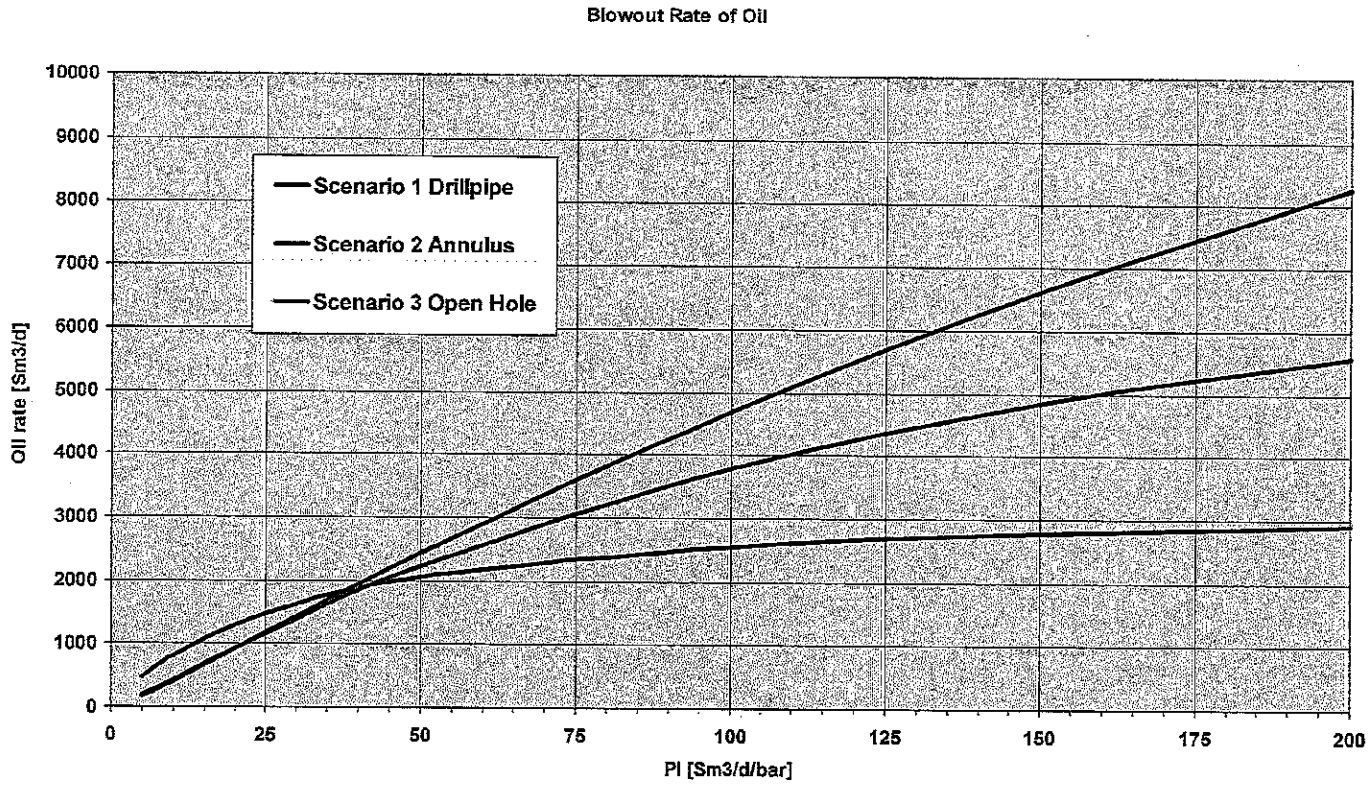


Blowout contingency - Worst Case Scenarios





Blowout rates



Kill requirements

- Flow through drillpipe and annulus
  - < 30 bpm down relief well
- Flow through open hole
  - 50 -> 80 bpm dependent on reservoir productivity

- Well design considerations
  - A simplified design with only 13 3/8 casing set will require a high relief well intersection point and two or more relief wells may be required

Well Control Operation

- Challenges facing a well control task force are becoming more and more complicated
  - deepwater, HPHT, long horizontal wells, mature fields
- Hydraulic modelling tools required for risk reduction measures are available today
- Flow diagnostics and hydraulic operational design drives the strategy for response
  - equipment and tools to use
  - which intervention method to use
  - how the operation should be controlled

Well Control Design

1. The analyzing phase
2. The planning phase
3. The execution phase

Well Control Design - Analyzing

- A well control simulator should actively be used to
  - Predict current flow situation in the well (pressure, temperatures, fluid types and rates)
  - Recapture the situation in the well prior to the incident

Well Control Design - Planning

- Modelling tools should be used to simulate the different intervention options

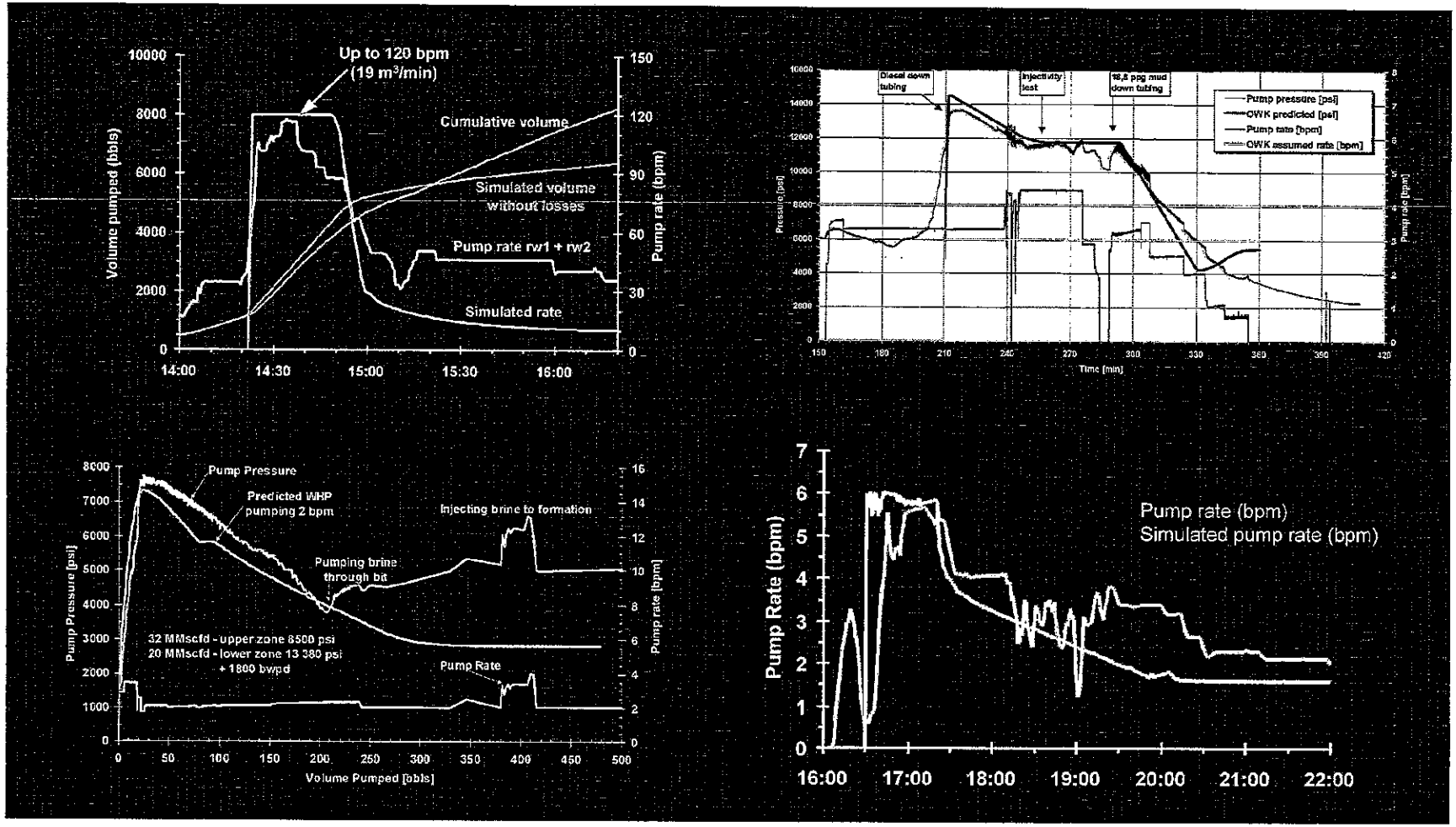
- Based on the results, the experienced well control engineers can
  - plan the optimum way forward
  - estimate resources required to perform the plan

Well Control Design - Execution

- Upon initiation of well control operations, the modeling tool is converted to an "online" simulator matching the operational parameters

- The plan is continuously updated during the execution and changes are validated with the simulator prior to actual implementation

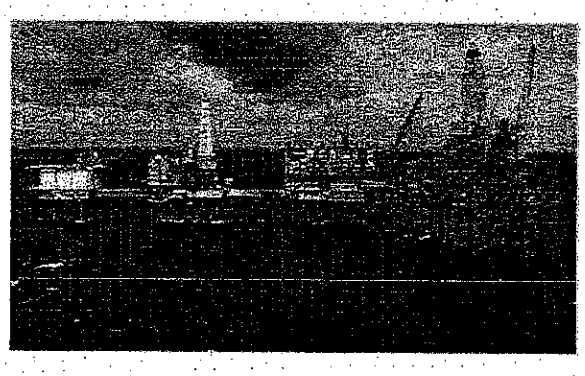
Olga-Well-Kill
Predictions vs observations



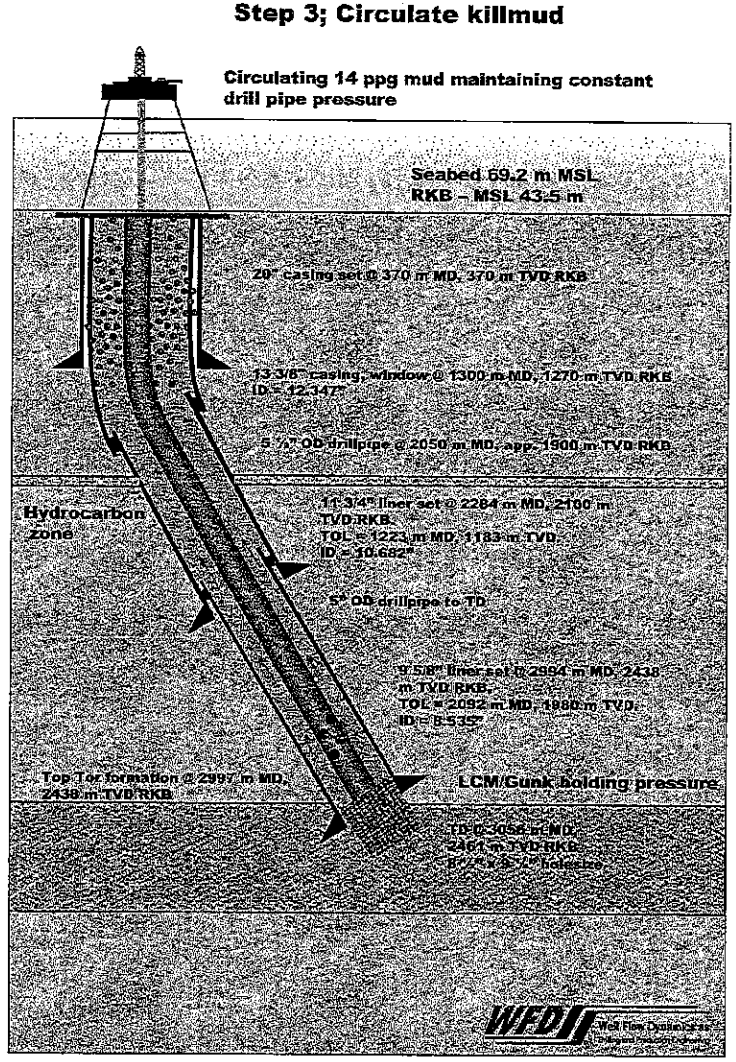
Case History

Well Control Incident on a production platform

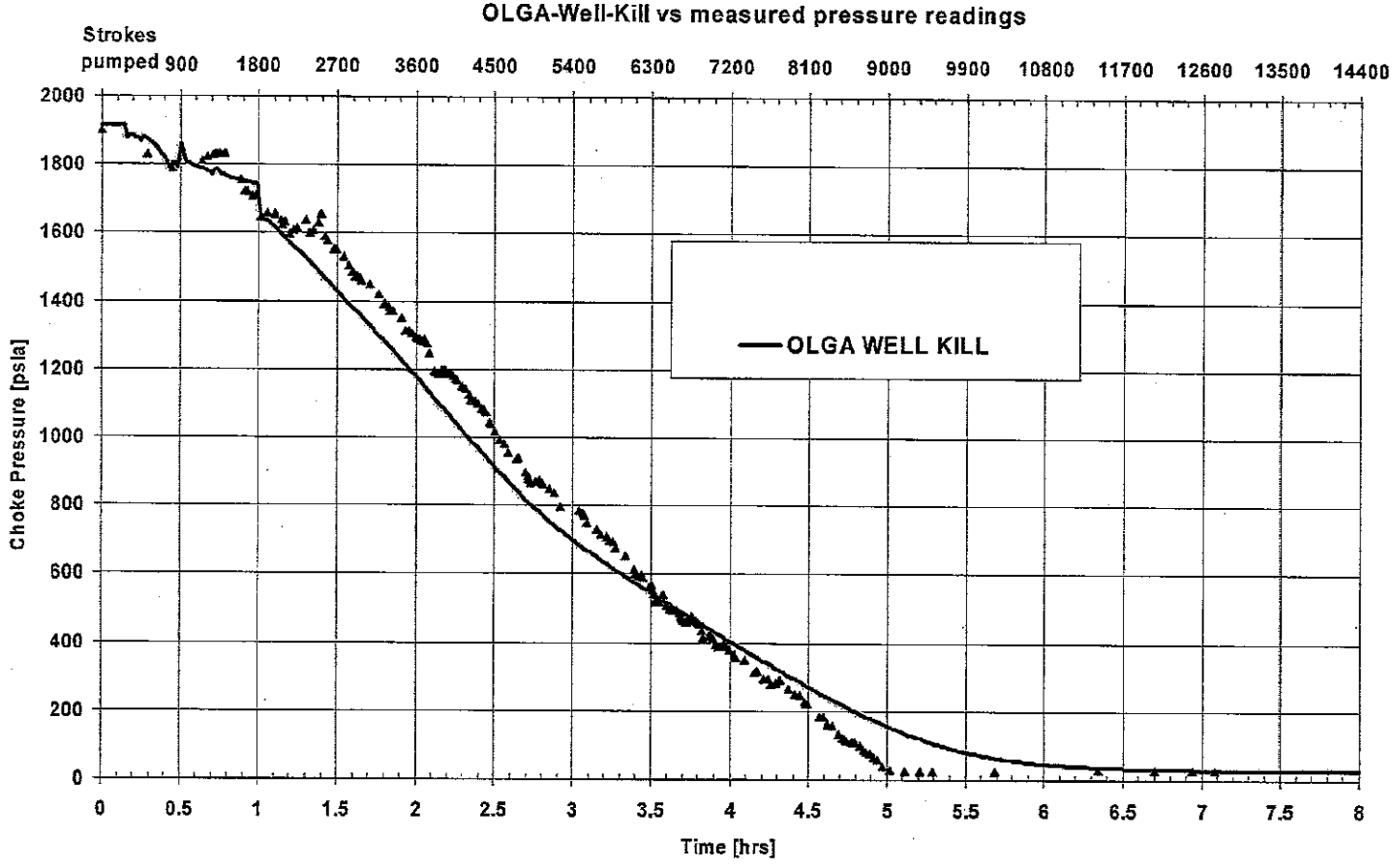
Well control situation North Sea

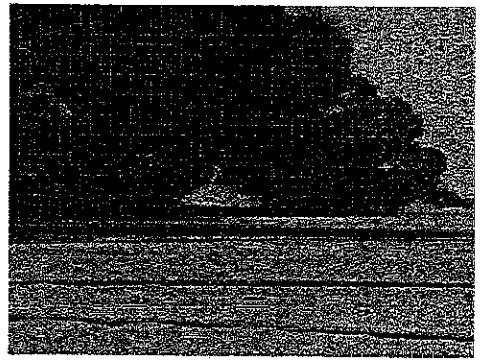


- Kick, shutin
- Low rating on 13 3/8" csg
- Evaluation
  - Circulate out gas to surface
  - bullhead back into formation



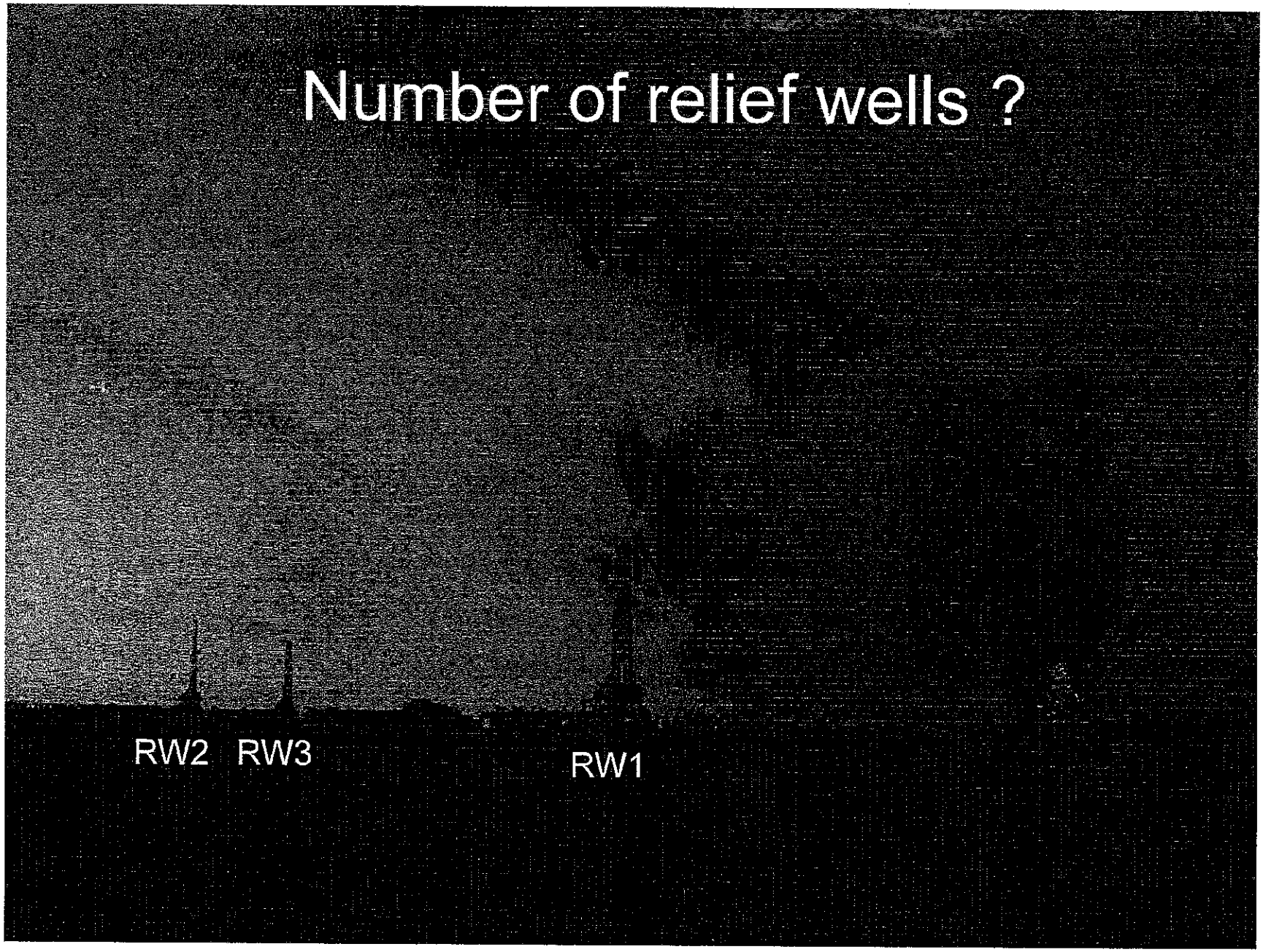
Predicted pressure vs measurement



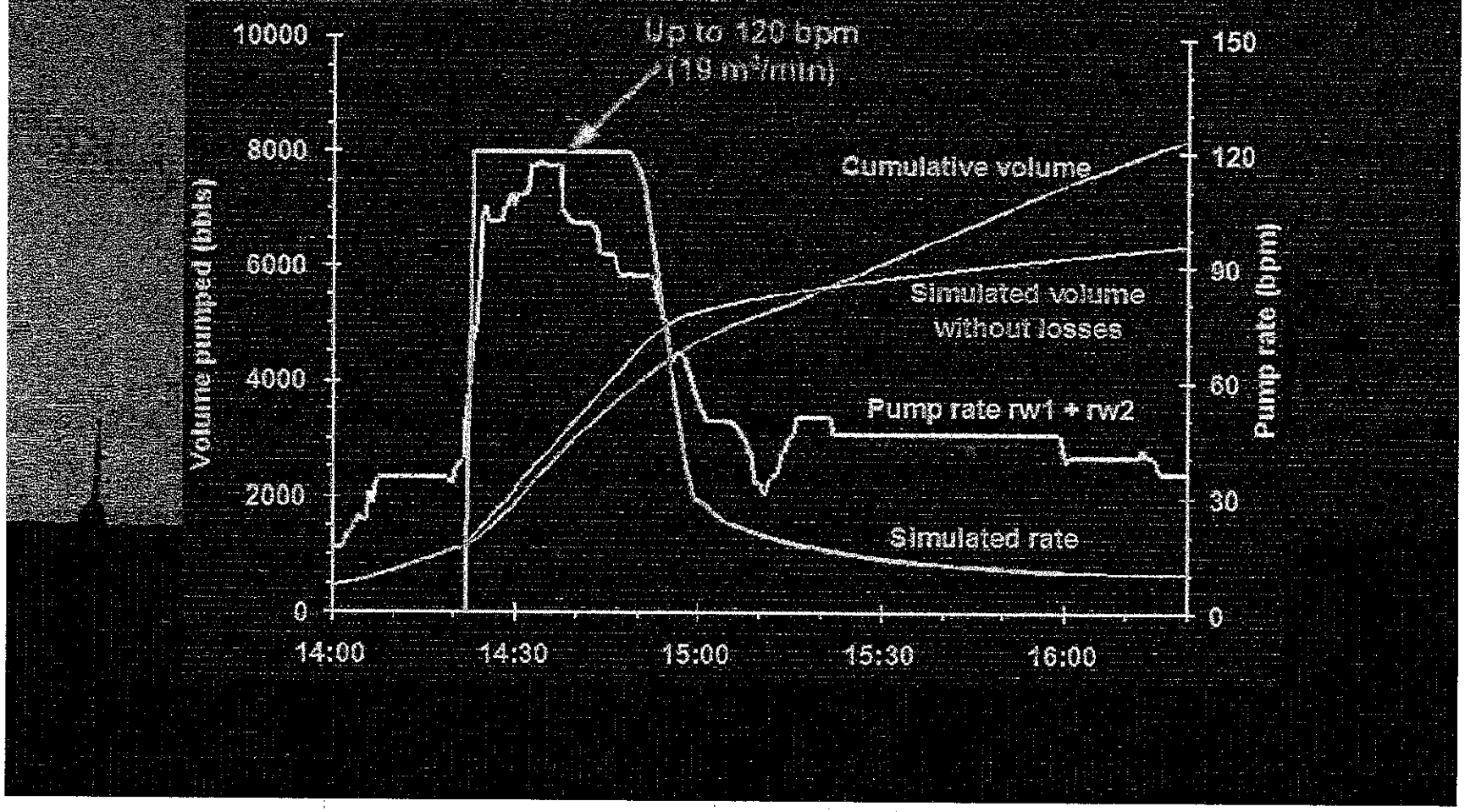


Case History

Oil Blowout - Syria



Kill planning with use of multiphase flow tool - OWK

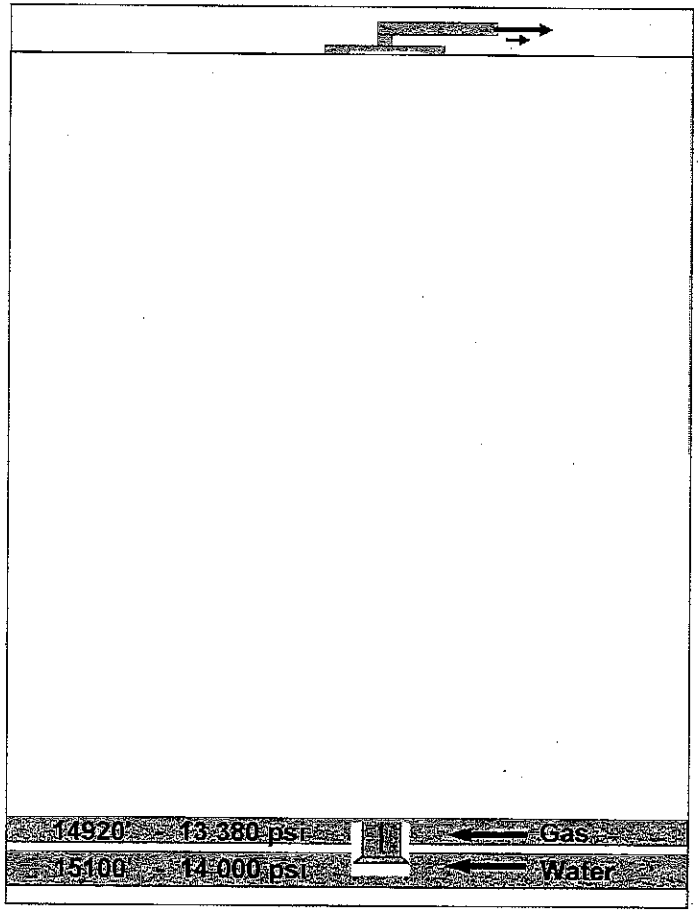


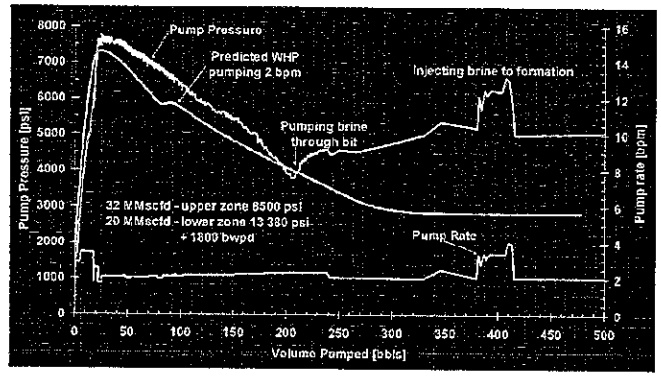
Case History

Bullhead kill

Bullheading

South Texas, Gas Blowout

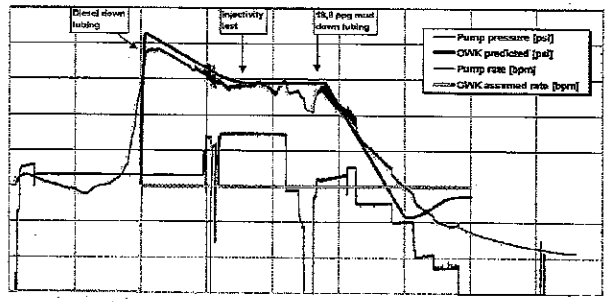


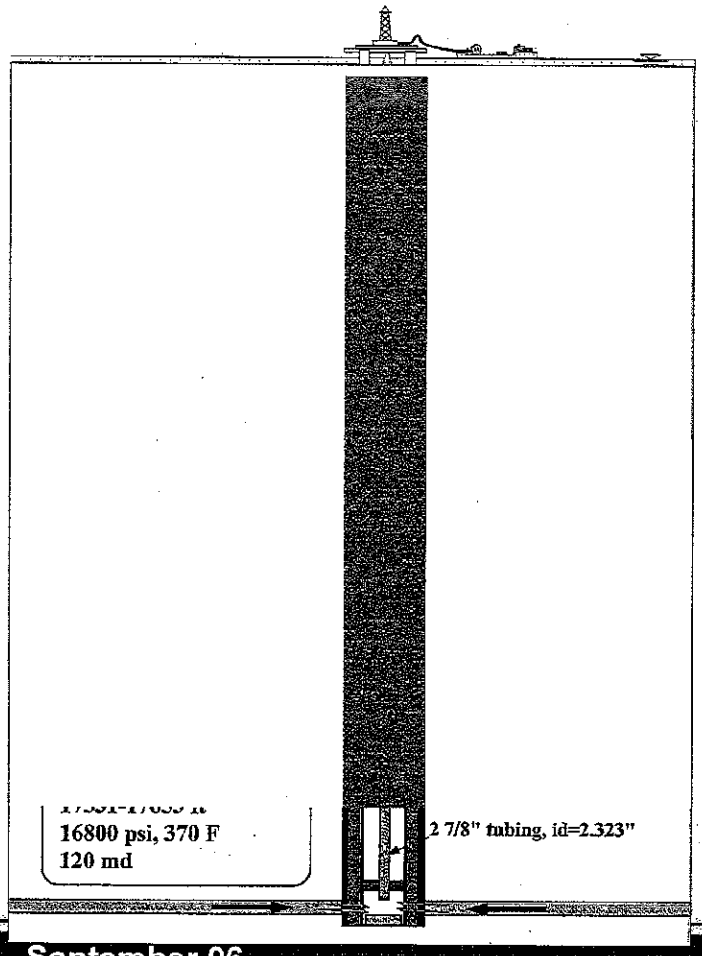


- Flow from two reservoir zones
- Mixed in water flow
- Communication with depleted reservoir
- 52 MMcfd gas 1800 bwpd
- Bullhead with 10 ppg brine

Bullheading

Gulf of Mexico - USA





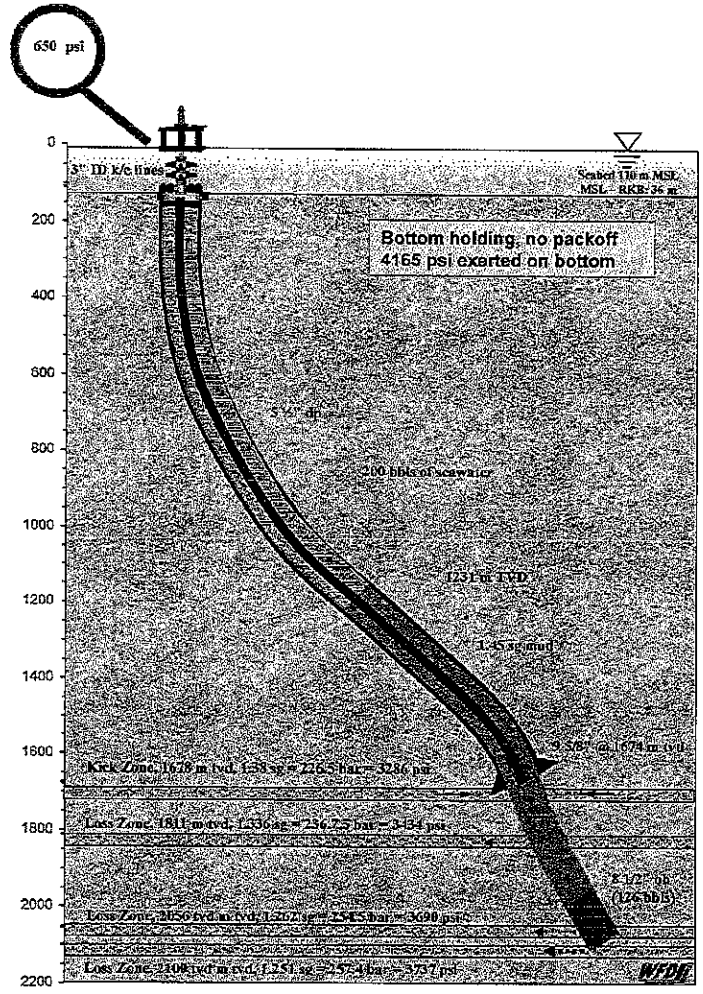
- Production platform
- HPHT
- Shut-in pressure
  14 560 psi = 1004 bar
- AOF = 745 mmscfd
- Kill with pumping
  diesel and 18.8 ppg mud
  down 3½" tubing at 3 bpm

Case History

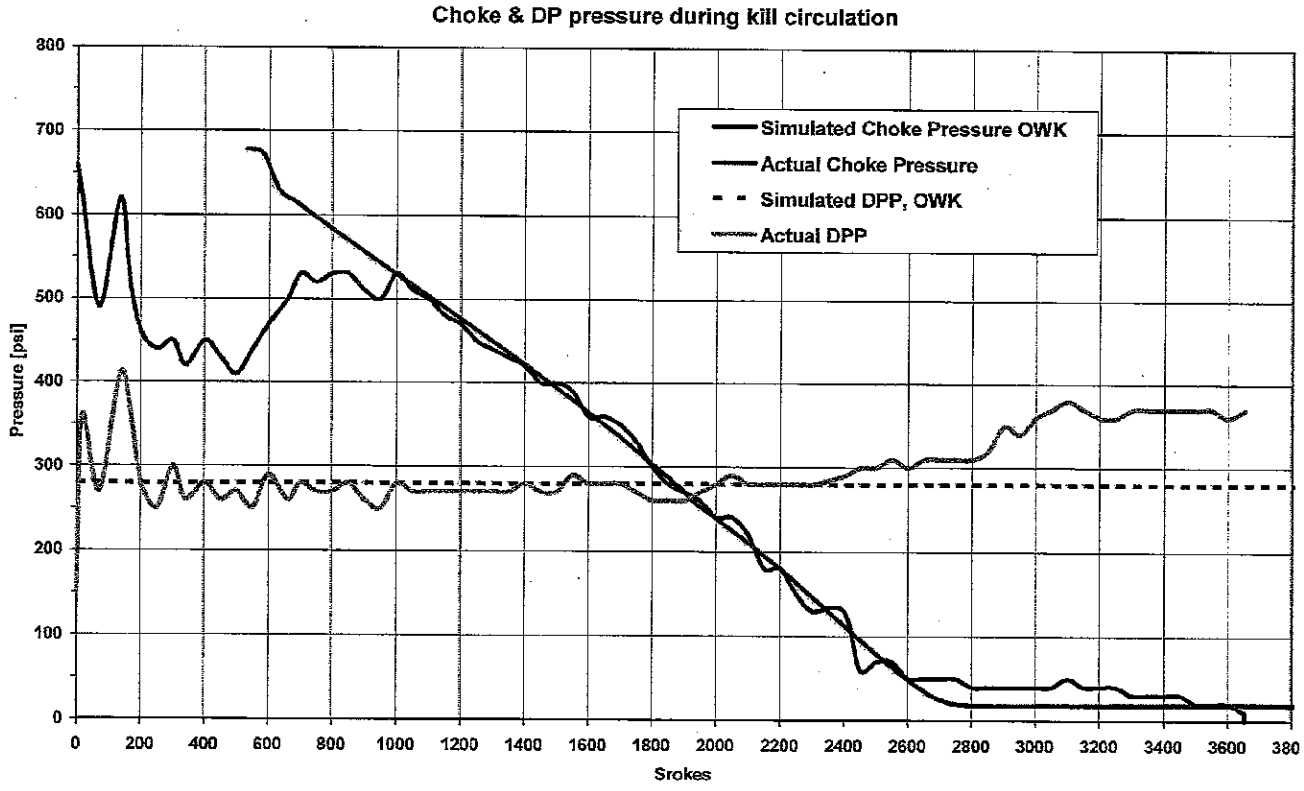
Well Control Incident on a semi-submersible drilling rig

Well control situation North Sea, UK

- Massive losses
- Kick, shutin well
- Fear of losing mud whilst circulating
- Simulations performed in order to be able to analyse situation and plan for gas removal



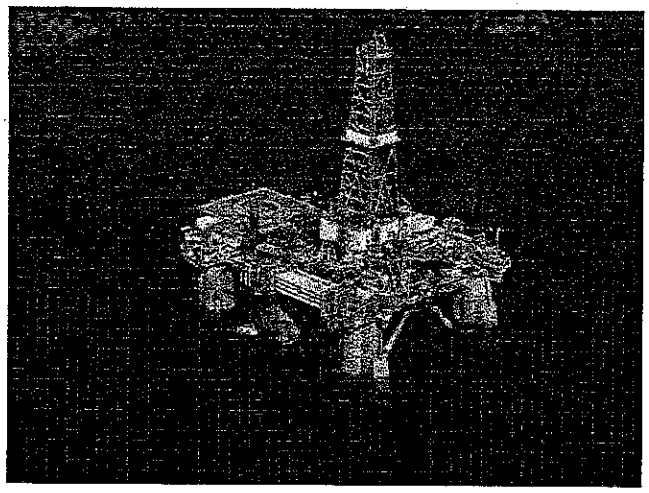
Predicted pressure compared to operational choke pressure



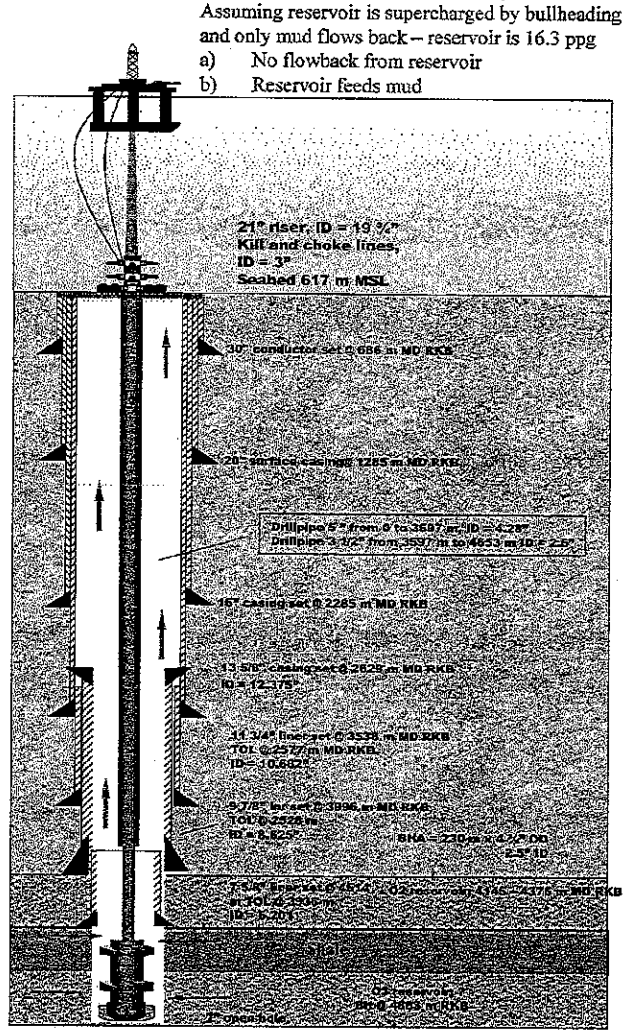
Case History

Exploration well – gas influx

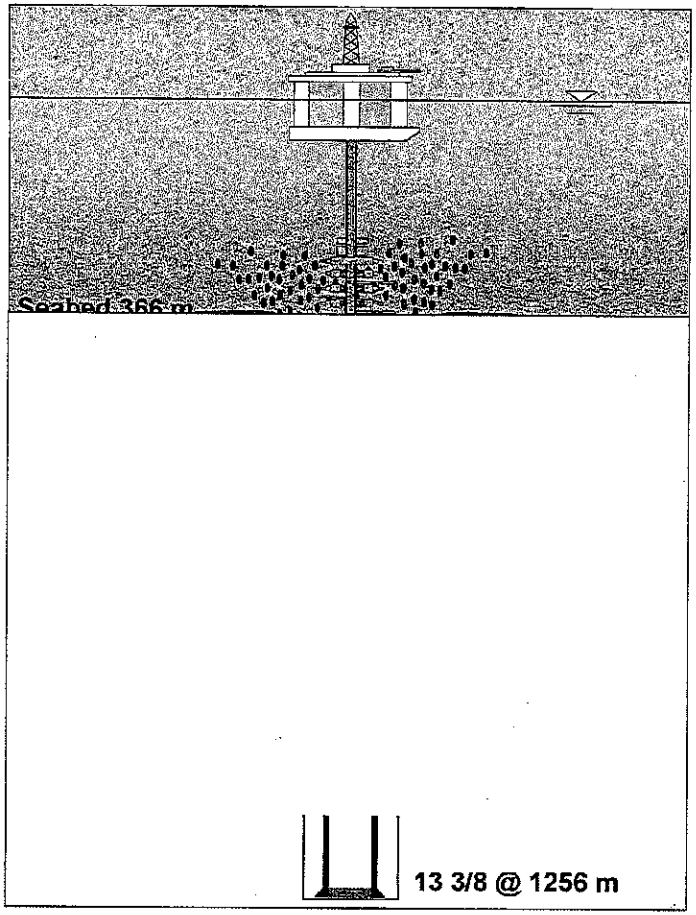
Egypt, Raven



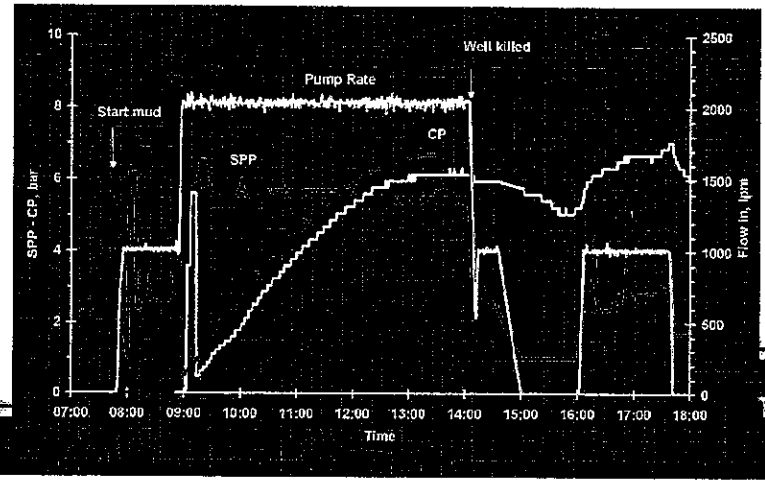
- Kick
- Gain during "driller's method"
- Bullheading



Shallow water flow



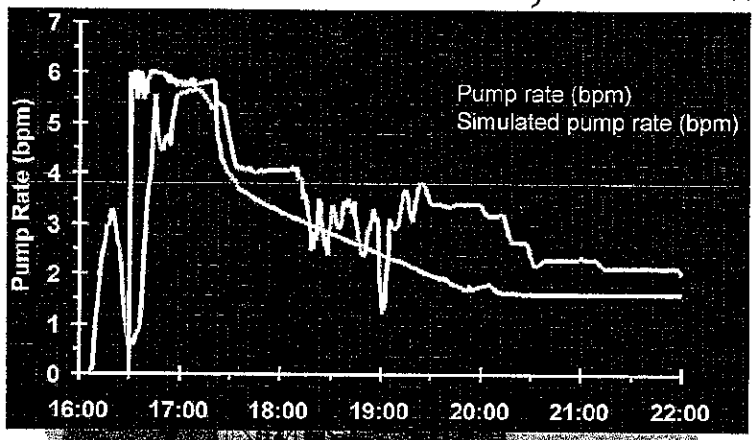
- Flowrate ≈ 4000 lpm
- Washed out volume ≈ 2000 m³
- Temperature and TDT logs
- Kill with pumping 1.6 sg mud
- Volume > 750 m³

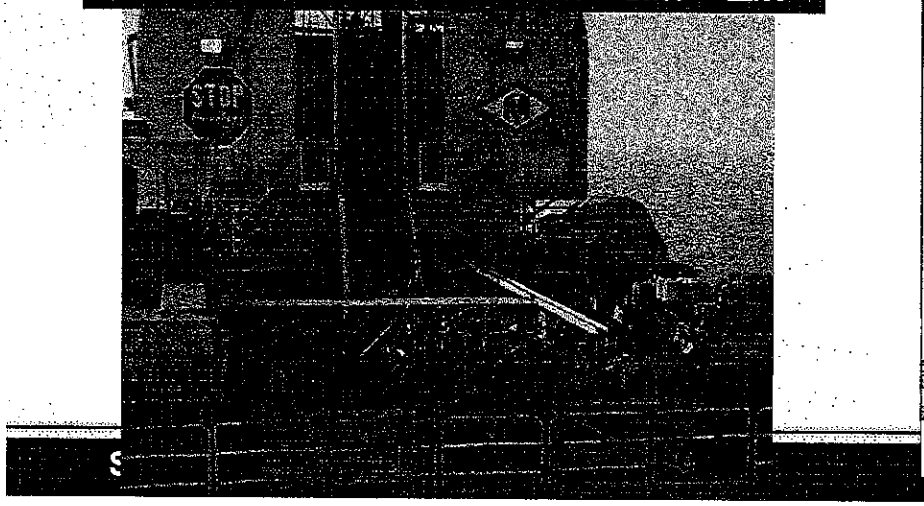


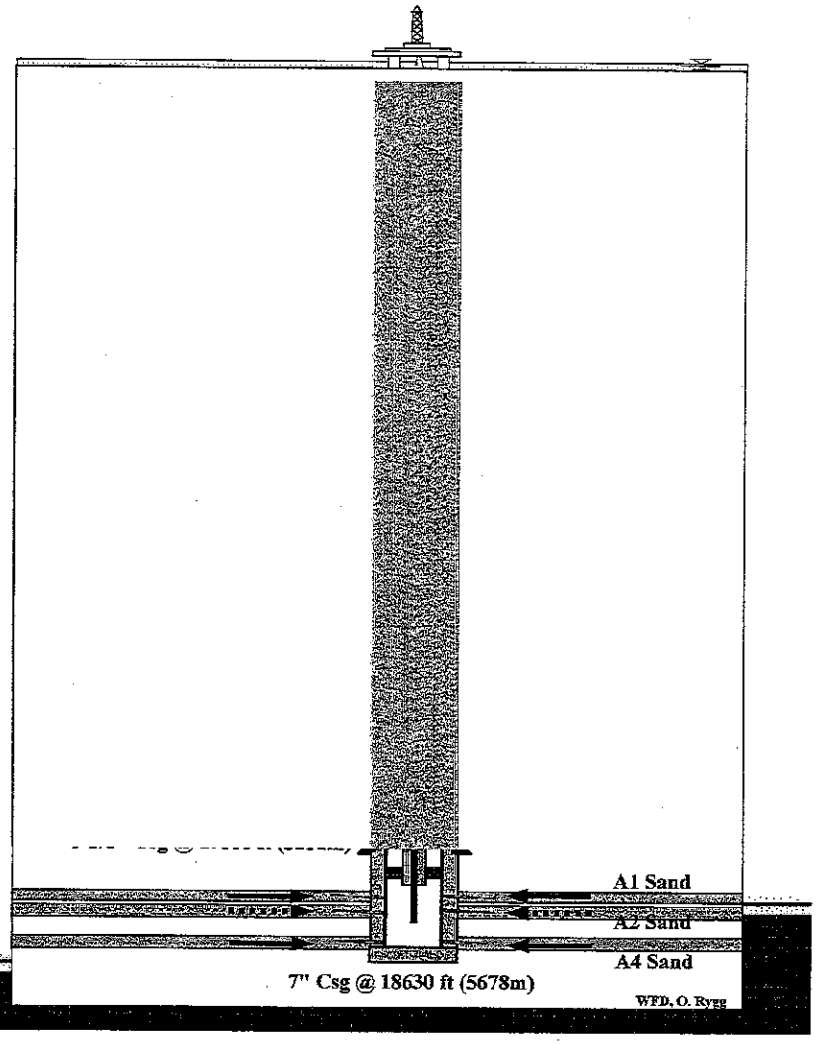
September 06

Underground blowout - cross flow

Gulf of Mexico, HPHT well





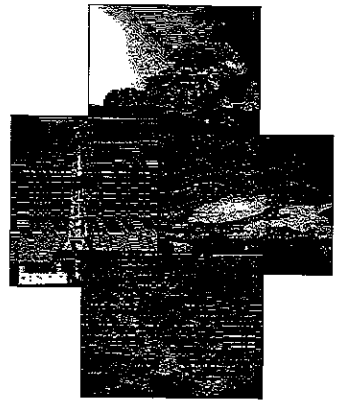


Well Flow Dynamics as
Drilling and Production Engineering

Well Flow Dynamics AS – Part 2
Olga-Well-Kill

Dr. Ole B. Rygg
President, Well Flow Dynamics AS

Houston, September 27, 2006

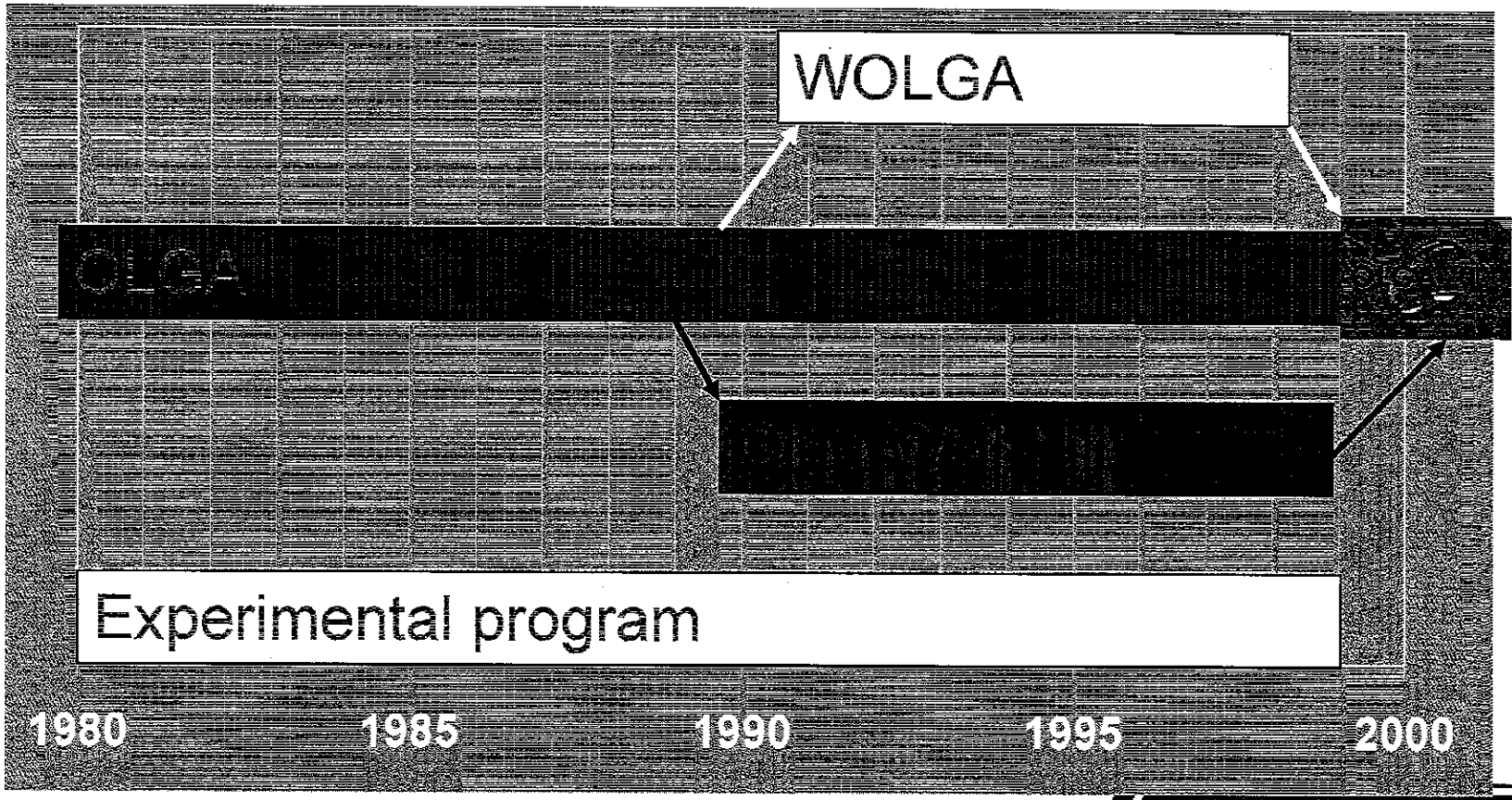


www.wellflow.com

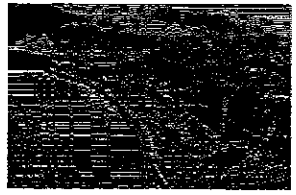
Multiphase flow model, OLGA

- Transient two fluid model
- Three phase flow in pipelines
- Finite difference formulation
- Implicit scheme - large time steps
- Dynamic flow regime transition
- Pipe and well networks
- Process equipment - controllers

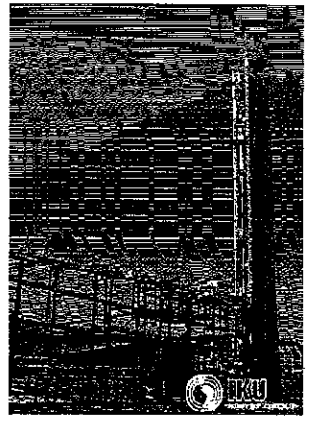
Development of OLGA



Olga-Well-Kill (powered by Olga)



- Capabilities
  - **Transient three phase model, controllers**
  - **Inflow models, PVT modelling, mud, brine etc.**
  - **Wellbore modelling, leaks, chokes, pumps etc.**
- Continuous development
  - **Olga development started at IFE in 1980**
  - **Initial development of OWK supported by Saga Petroleum 1989-92 after 2/4-14**
  - **Olga-Well-Kill powered by OLGA, current state of the art multi-phase software code**
  - **OLGA development supported by all major oil companies (> 100 mill. USD)**
- Verified by test loop and blowout data

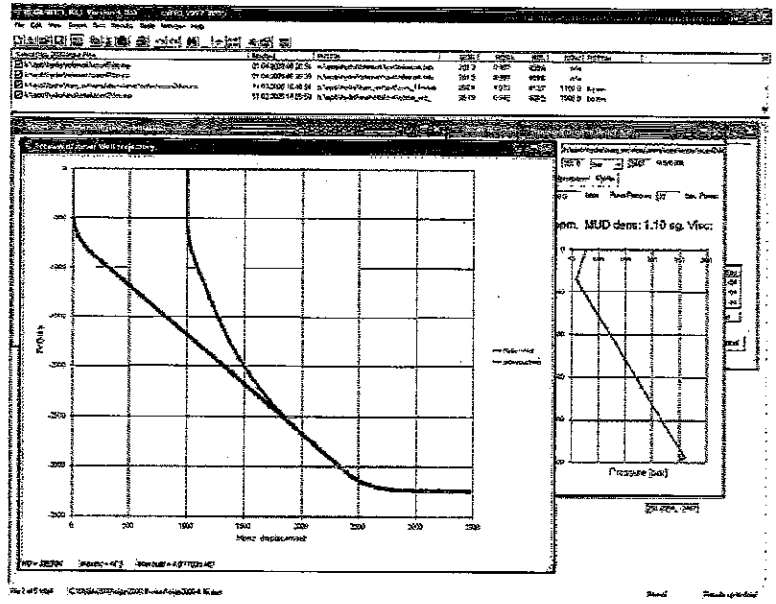


Olga - Well -Kill, Features

- State-of-the-art multiphase flow technology
- Advanced controller system, match actual pumping
- High pressure pump models
- Oil and gas properties fully modelled
- Pressure and temperature effects on kill fluids
- Non-Newtonian and critical flow conditions
- Any kill fluid: Mud, water, brine etc.
- Flow through bit-nozzles, obstructions and leaks
- Friction loss through tool joints.
- All reservoir inflow models can be used
- Graphical interface

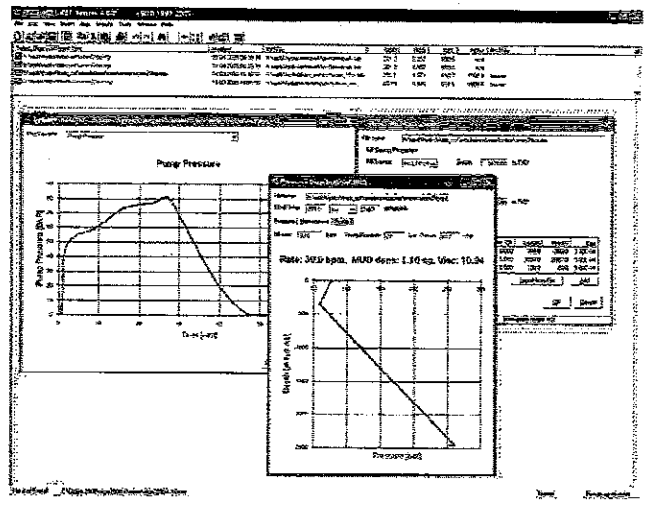
Well bore modelling

- Flow path discretisation
- Reservoir inflow
  - Linear, quadratic, combination, tables
  - Injectivity, losses, fracturing
- Handles multiple phases
- Controller system



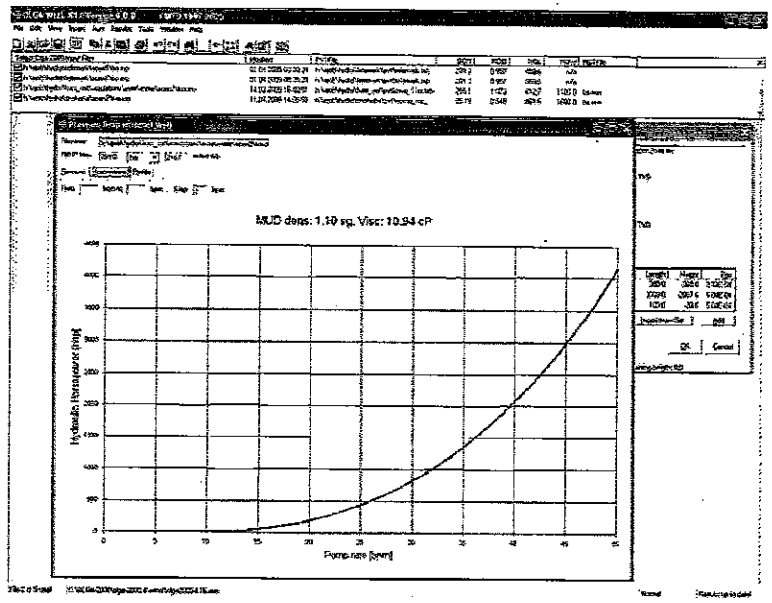
Well bore modelling

- PVT analysis
- Fluid property variations
  - vs Pressure and Temperature
  - vs Time and Position
- Non-Newtonian fluid flow
  - Bingham, Power law, Herschel-Buckley

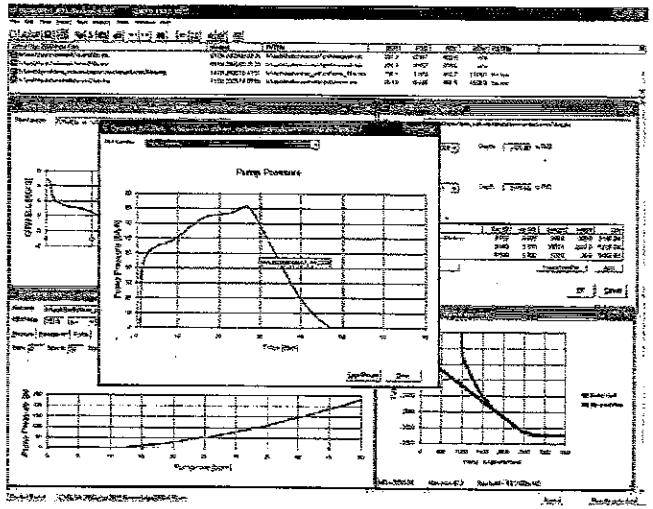


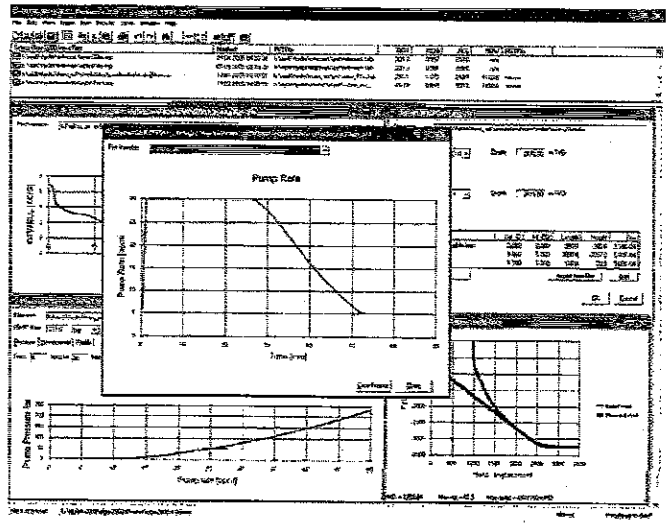
Well bore modelling

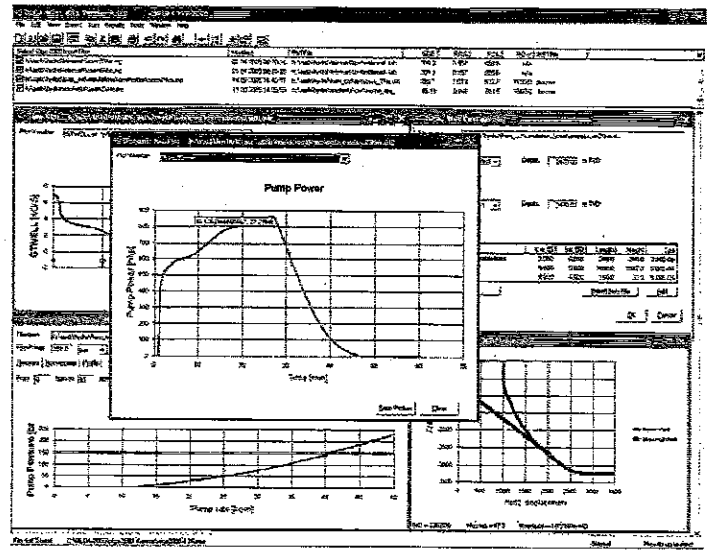
- Pumps and compressors
- Critical and sub-critical chokes
- Flow through bit nozzles
- Internal and external pipe upsets



$$C_{\varepsilon} = e^{(4.26 - 0.06\lambda_u)(\alpha - 1)}$$



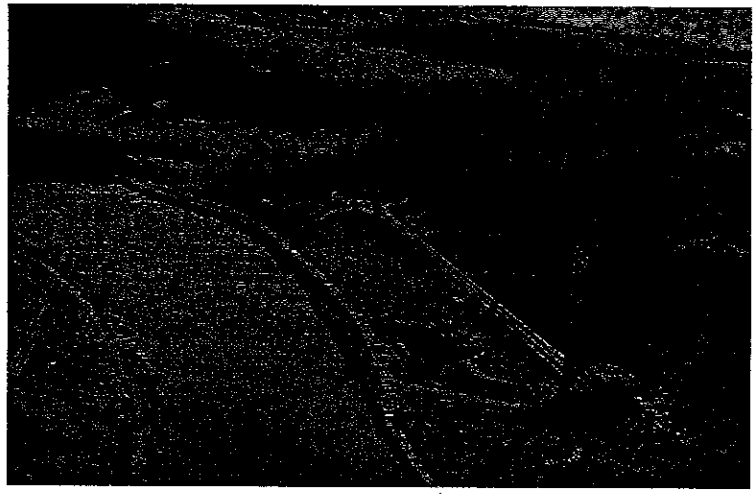


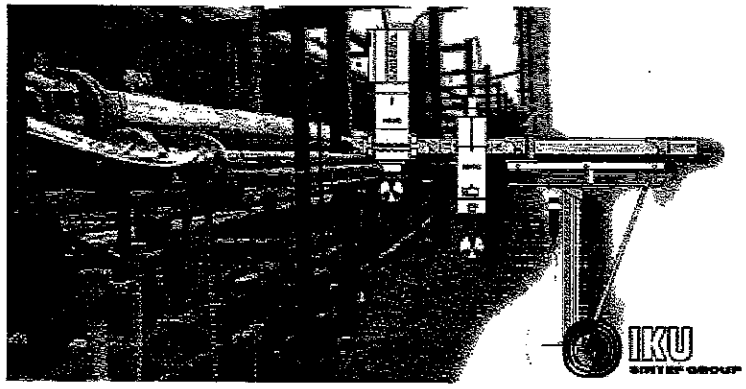


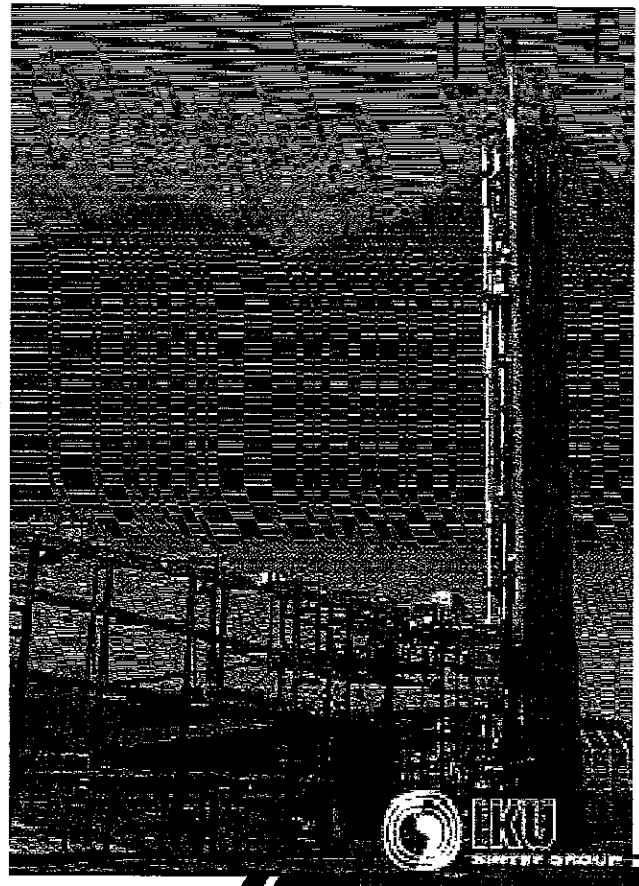
Verification of the core model

- Large scale experimental loop
  - High pressure, Build in 1980 by Exxon
- Medium scale loops
  - 10 bar, Inclinations, different fluids
- Small scale loops for study of details
- Comprehensive field data verification

Large scale flow loop, SINTEF

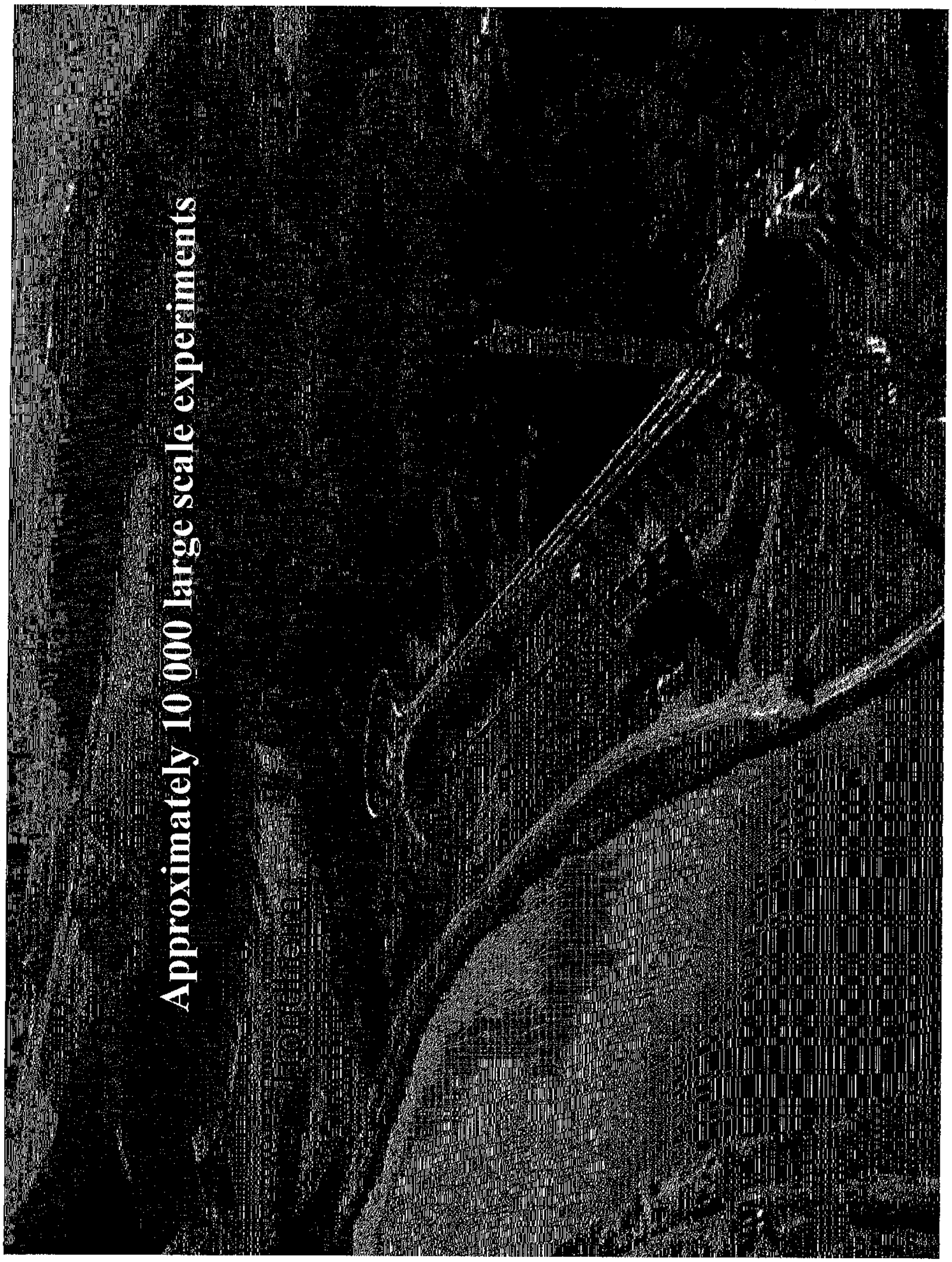






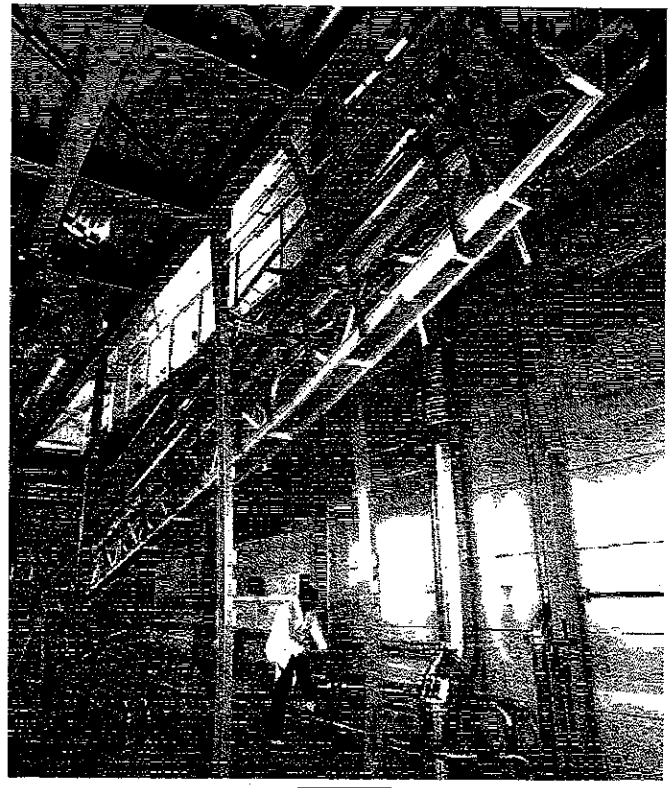
Multiphase flow facilities at SINTEF

- Large scale flow loop
  - 8" carbon steel pipeline with 50m riser
  - Pipe length, 1000m - 3280ft
  - 12", 8" or 4" pipe sections
  - Pressure=110bar
  - Nitrogen, condensate, diesel or lube oil
- Medium scale flow loop
  - 100m - 328ft, 3" PVC pipe
  - Air, water and oil at 10 bar


Approximately 10 000 large scale experiments

Multiphase flow facilities at IFE

- **Low pressure loop**
  - Air-water-oil, -10º ☑10º
- **Inclined flow loop**
  - Gas-water-oil, 0º ☑10º, 10bar
- **Well flow loop**
  - Gas-water-oil, 0º ☑90º, 10 bar
- Instrumentation
  - Gamma densitometers
  - Laser doppler velocimetry
  - dP-transducer
  - High speed film camera & video



Theory and Practice

- Olga-Well-Kill combined with 15 years hands-on experience has proven to be a very reliable combination

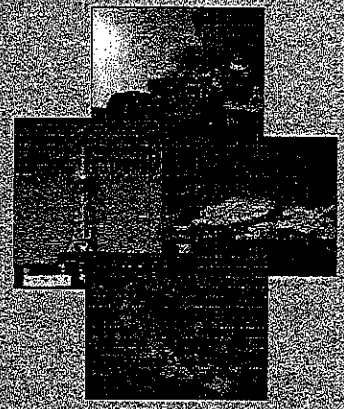
Only available from WFD

Well Flow Dynamics as
Drilling and Production Engineering

Well Flow Dynamics AS
History – Organization – Services

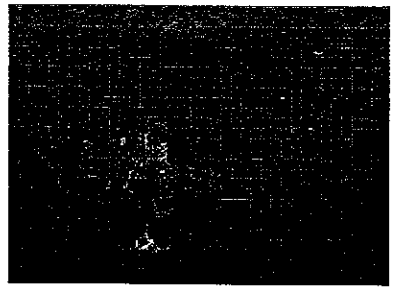
Dr. Ole B. Rygg
President, Well Flow Dynamics AS

Houston, September 27, 2006

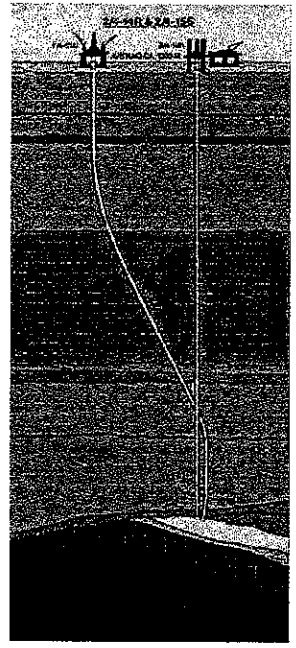


www.wellflow.com

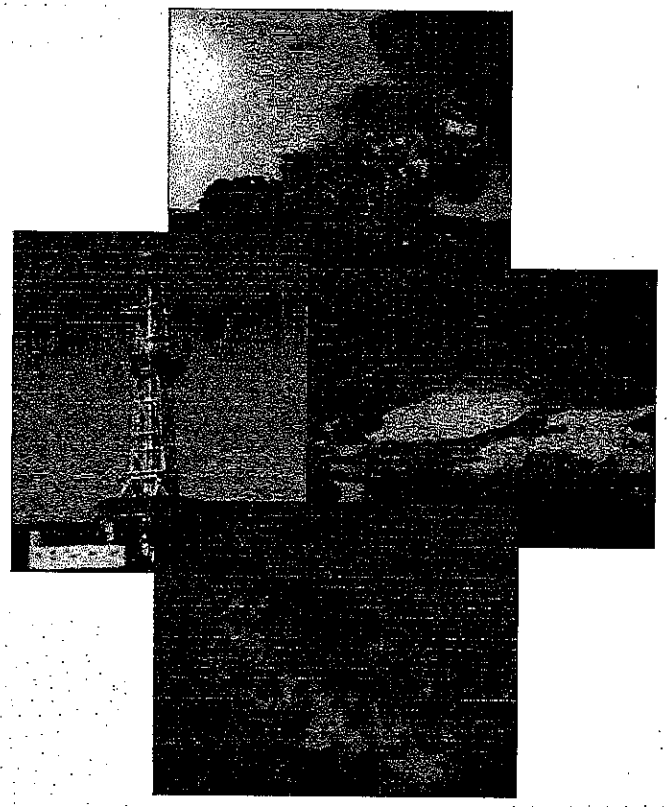
Well Flow Dynamics as

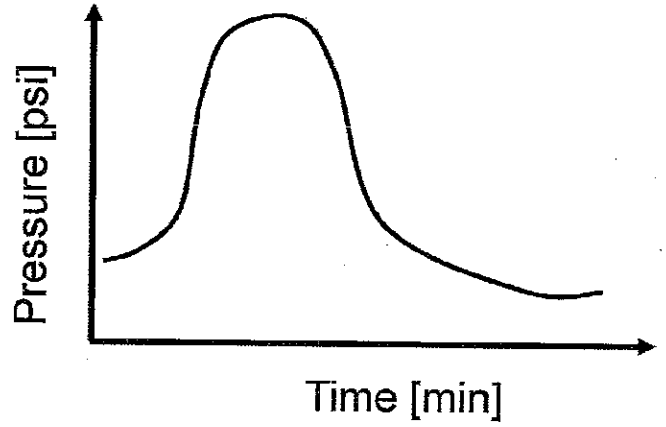


- Saga 2/4-14 blowout in 1989
- Research in market after a simulator capable of handling transient two / multiphase flow
- Kill operation simulated with a “modified OLGA” developed during the blowout
- Well killed by pumping down relief well
- Research program initiated, sponsored by Saga, lasted for 2 years
- Olga-Well-Kill
- WFD formed 1991



Well Flow Dynamics AS





"Market leading supplier of transient flow calculations for well control incidents and contingency planning"

WFD - Clients

- Clients
  - **ADMA, Aker, Agip, Amoco, Apache, Arco, Astra, Banoco, BP, BP-Amoco, Barrett, Bellevue, Chevron, CNG, Conoco, Deminex, Det Norske Veritas, Elf, Enterprice, Exxon, FIOC, Hydro, IFE, Jones Co., Lou Little, Maersk, Marathon, Mexpetrol, Mobil, MOL, Newfield, NZOP, Occidental, OGDC, OKIOC, Petrobras, QGPC, Saga, Shell International, Shell US, Sonangol, Sonatrach, Smedvig, SSI, Statoil, STOS, Texaco, Total, Unocal, UzPec, Vern Jones, Woodside, Wintershall**
- Countries
  - **Algeria, Angola, Argentina, Australia, Bahrain, Bangladesh, Brazil, Brunei, Canada, China, Colombia, Denmark, Hungary, Indonesia, Kazakhstan, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Qatar, Syria, Thailand, UAE, UK, USA, Uzbekistan, Venezuela, Vietnam**

WFD – Experience

Selection of some major blowout projects

Company	Location	Year	Type
Hydro	North Sea	2006	Shallow Gas
LGDC	Onshore, US	2005	Gas-Oil Blowout, RW
BP	GOM	2005	Platform incident
UzPec	Uzbekistan	2004	Gas-Oil Blowout
Shell	Brunei	2002	Dual intersection RW
Shell	Brunei	2002	Gas Blowout - RW
TFE	Indonesia	2002	Gas Blowout - RW
Bean	Mississippi, USA	2001	HPHT, H2S, Blowout
Mol	Hungary	2000	Major Gas blowout
Sonatrach	Algeria	2000	Major Gas blowout
Newfield	GOM, USA	1999	Gas blowout
Bellevue	California, USA	1999	Gas-cond.-water blowout
Barrett	Wyoming, USA	1998-99	Gas blowout
Occidental	Bangladesh	1997-98	Cratered gas blowout
Shell	Syria, land	1995	Broached oil/gas
Lou Little	Texas, land, USA	1993	Gas/water, broached
Mexpetrol	Argentina	1993	Broached, gas cap bo
BP	Vietnam, offshore	1993	Broached, cratered
Vern Jones	California USA	1992	External gas/water
Corpoven	Venezuela	1990	Underground broached
Saga Petroleum	North Sea, Norway	1989	Underground blowout

WFD – Experience

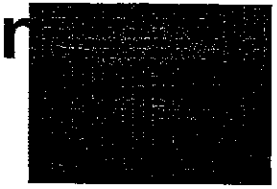
Recent Well Incident and Contingency Work

Company	Location	Year	Type
BP	UK	2005	HPHT Well incident
Statoil	Snorre A	2005	Re-drilling - Contingency
BP	Black Sea	2005	Hopa contingency plan
Hydro	Norway	2005	Gas solubility in mud
BP	UK	2005	Clair contingency plan
BP	UK	2005	Schiehallion, bullheading
BP	Angola	2004	Blowout Contingency Plan
Shell	Nigeria	2004	Gas blowout
UzPec	Uzbekistan	2004	Oil/Gas Blowout
BP UK	North Sea	2004	Kick Incident
BP Egypt	Med. Sea	2004	Kick Incident
Statoil	Snorre 'B'	2004	Dynamic Kill Options ,Completion
Shell	New Zealand	2004	Well Connection Project
Hydro	North Sea	2004	Multilaterals
Statoil	North Sea	2004	Field study
Hydro	Area 'C, Stetind	2004	Blowout Contingency Plan
BP	Norway, Valhall	2003	Kick Incident

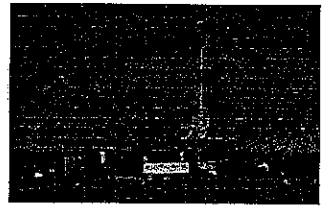
WFD Services

Well Control

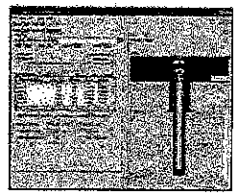
Production Engir



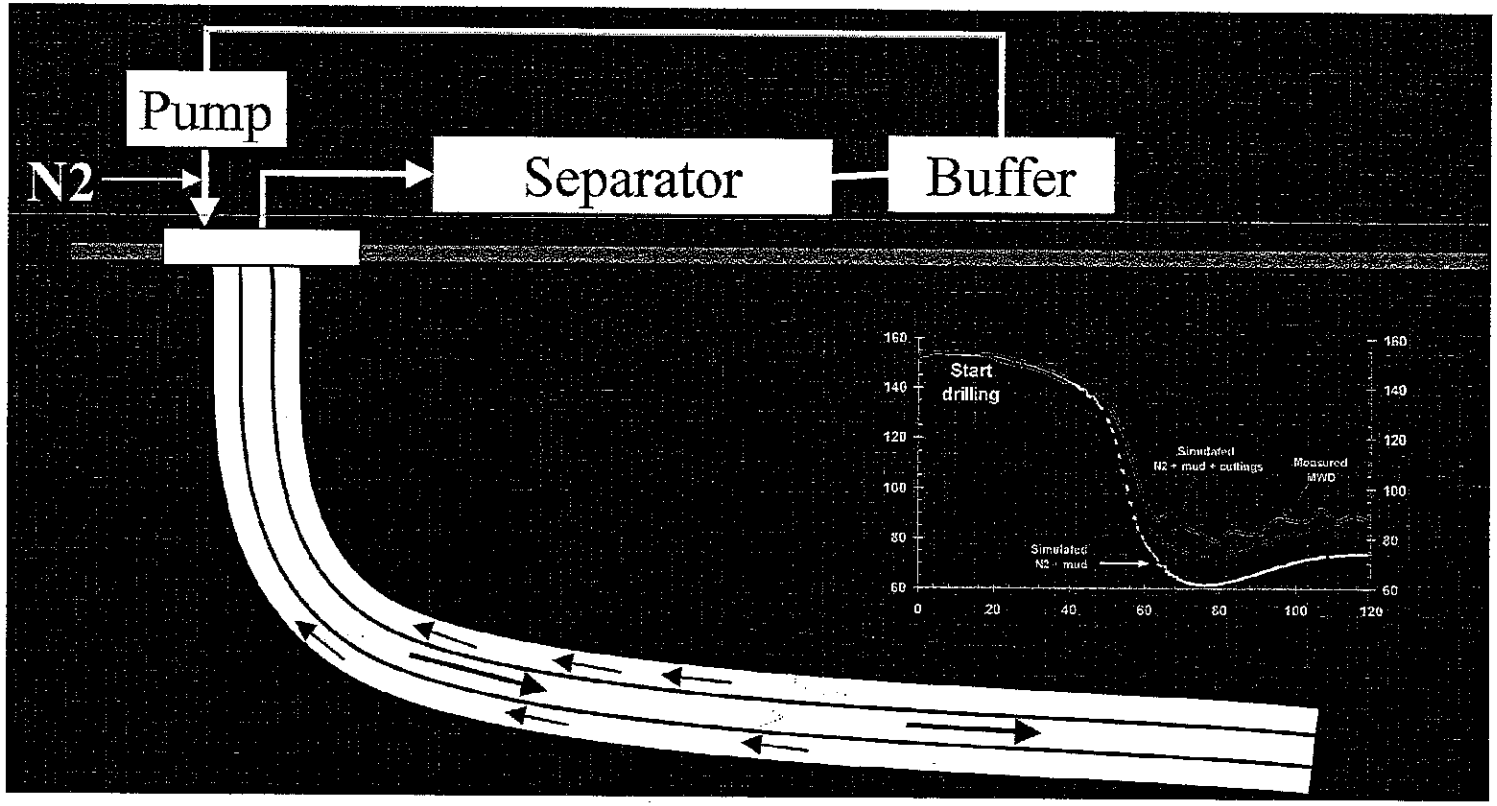
Drilling Engineering



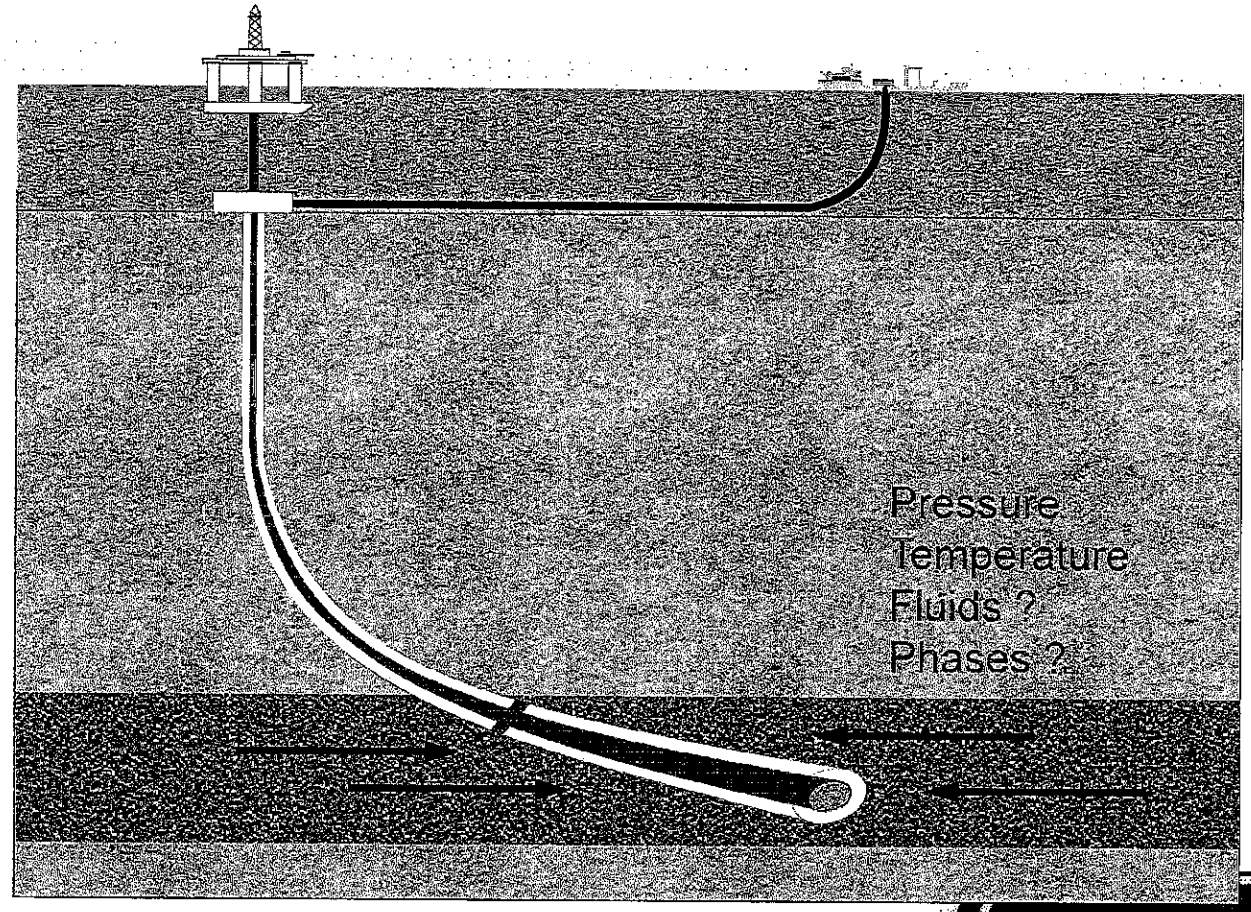
Software Development



Underbalanced Drilling

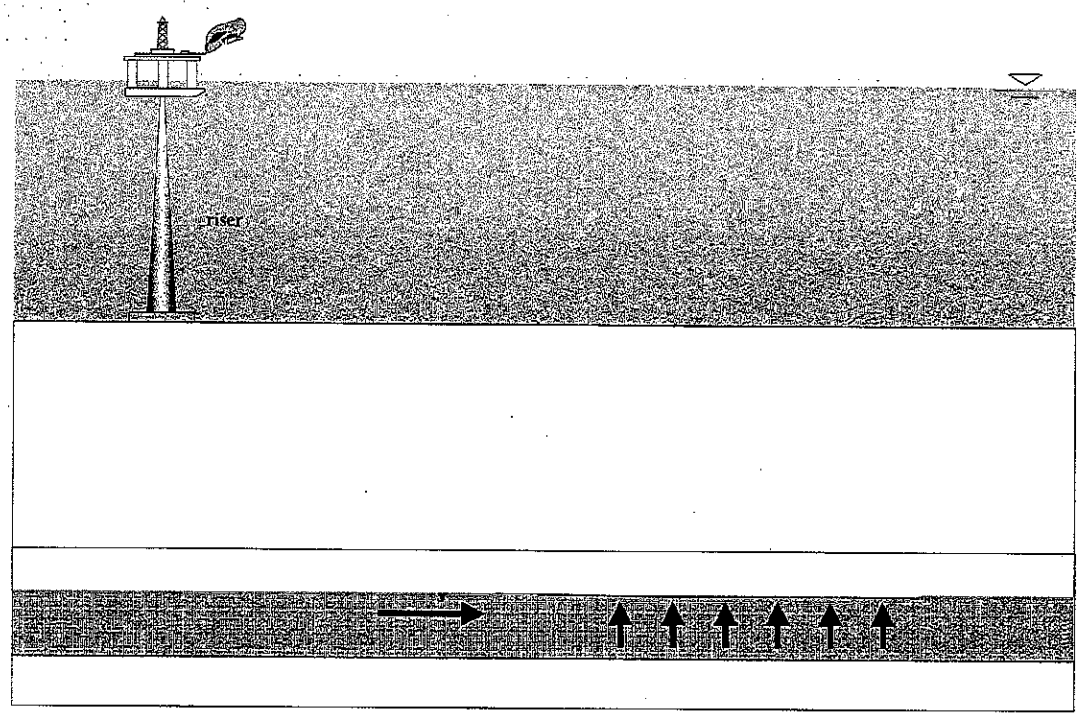


Multiphase flow in wells

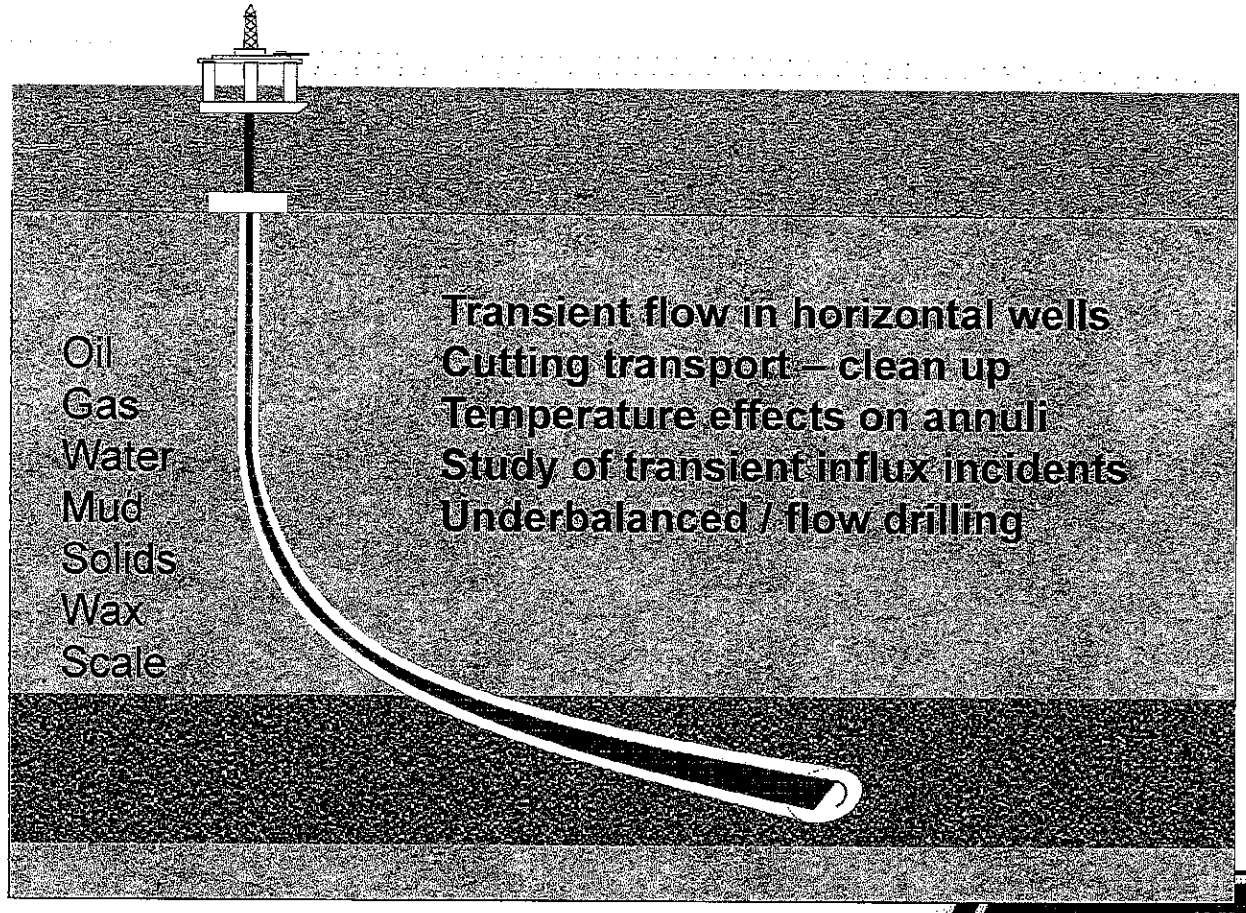


Well testing

- Temperature effects
- Transient inflow dependence
- Flow from various zones
- Well testing while drillling

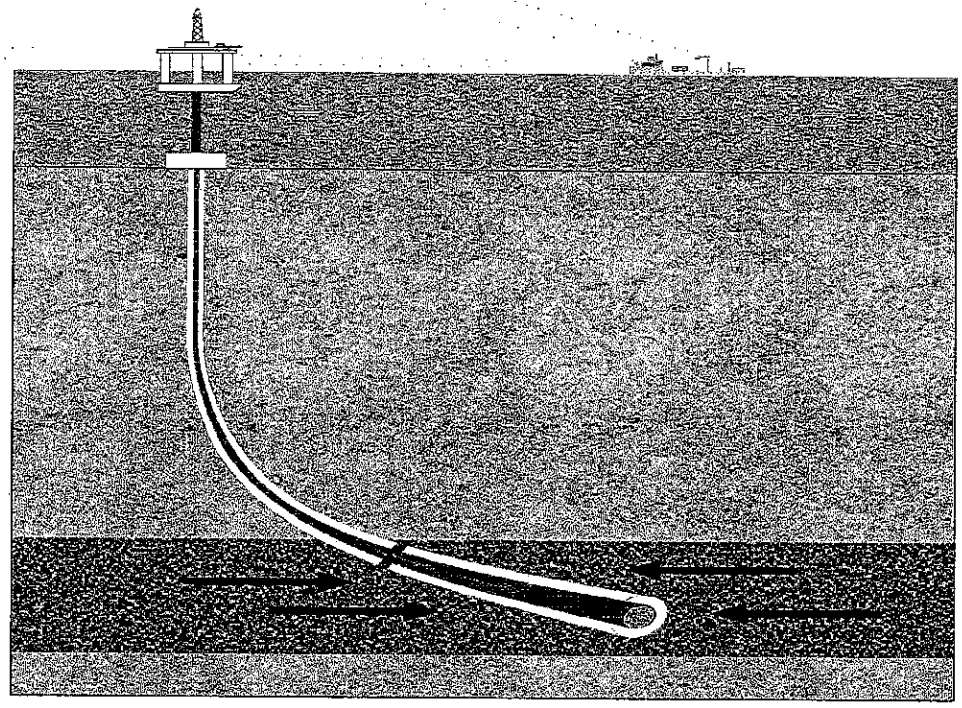


Drilling

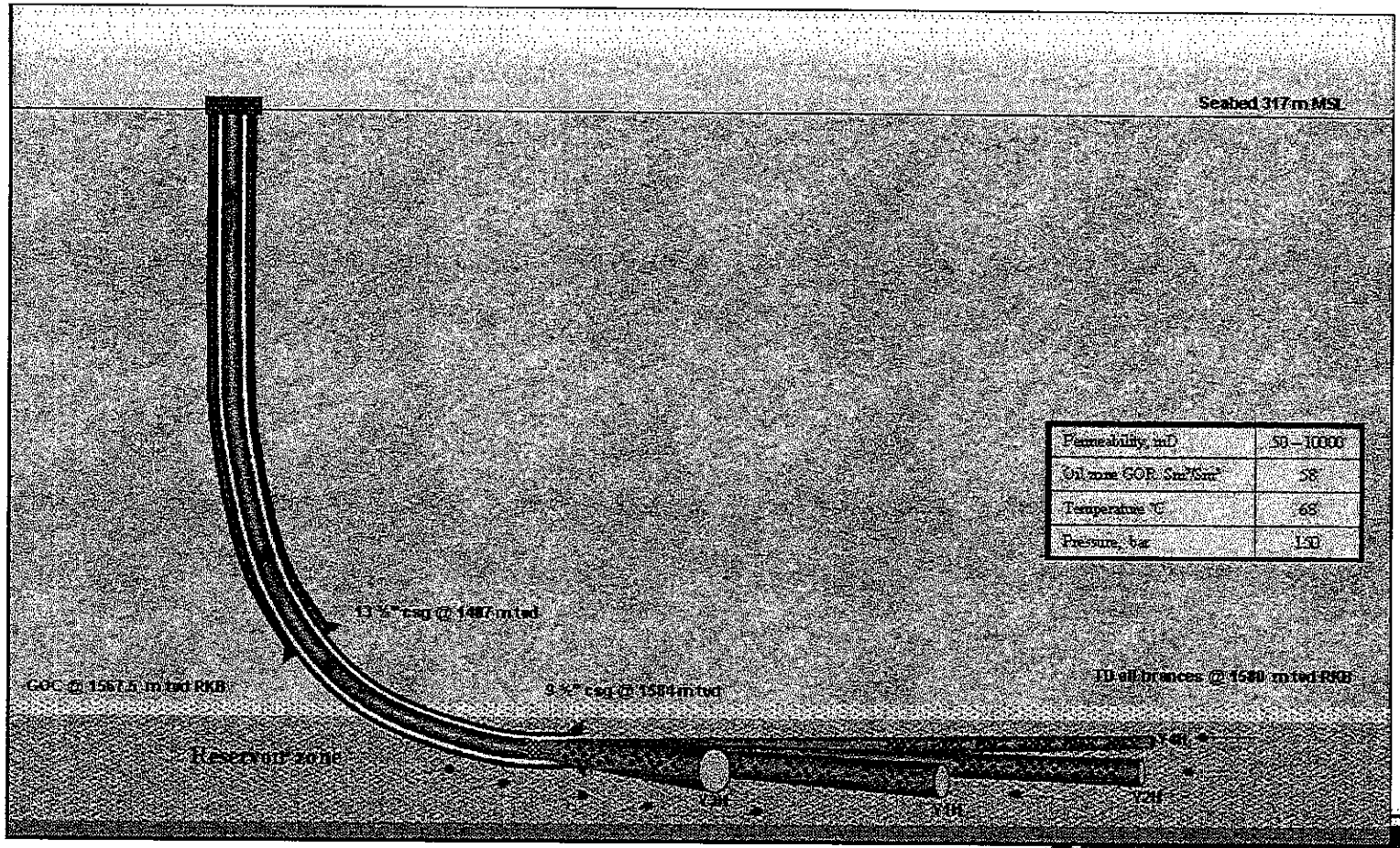


Long reach drilling

- Fluid behaviour in horizontal wellbore
- Transport of cuttings during drilling
- Clean-up of wells



Multilateral wells



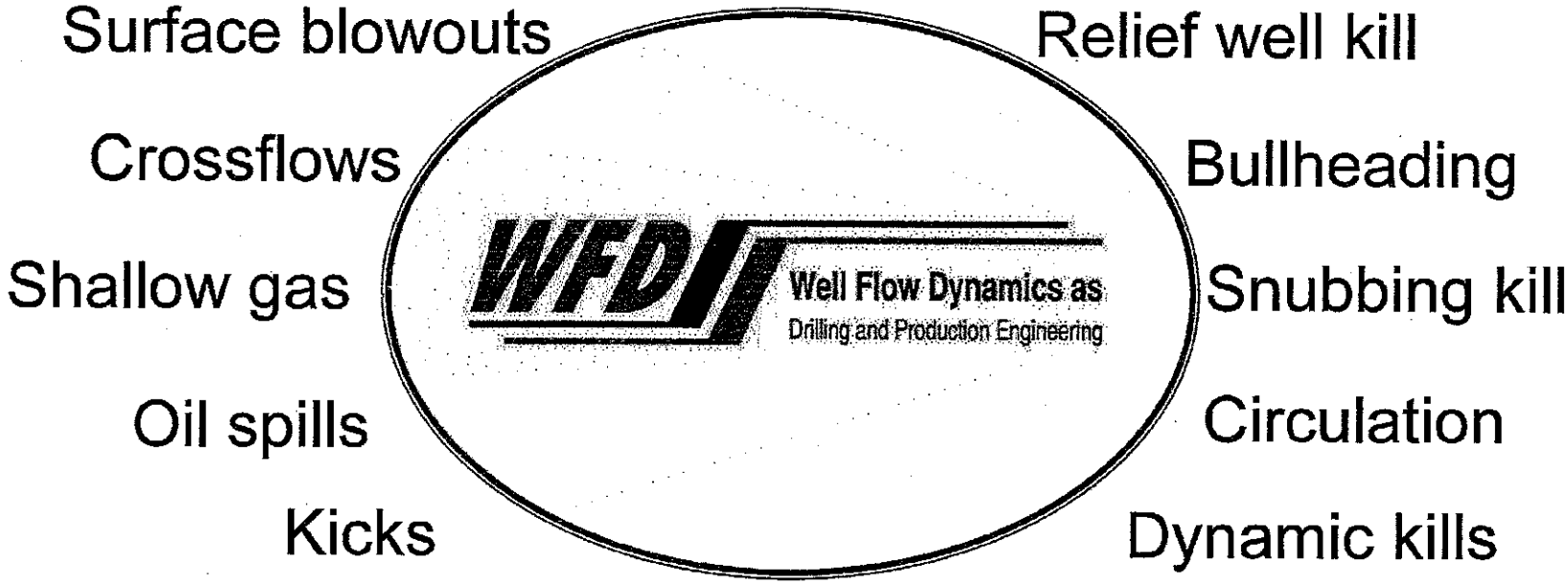
Well Control

- Well Design
  - Evaluate casing program, Kick tolerances, Cross-flow problems, Pressure/Temperature tolerances, Testing
- Contingency Planning
  - Model hypothetical blowout incidents based on the drilling program (flow rates and durations)
  - Estimate well control resources (kill method, kill rates, pressures and volumes)
- Special Projects
  - Field studies, risk evaluation of new technology.
- Emergency Response
  - Advisors on well control incidents (Kick, Bullheading, Crossflow, Blowouts)

Planning Well Control Operations

- Kill intervention type
  - Dynamic kill, Bullheading, Top / snub kill, Relief well kill, Combinations
- Pumping Schedules
- Kill fluid type and volume
- Temperature Predictions
- Monitoring programme

Blowouts and critical well operations



Contingency Planning

WFD's Unique Position

- 15 years experience
- Only company providing this service - Worldwide
- Highly competent personnel
- Olga-Well-Kill – the market's only multiphase, transient flow simulator custom made for well control application
- Validity of simulator proven in practice on numerous incidents all over the world

Personnel

- Highly competent personnel (Master or PhD) with experience from the following areas;
  - Multiphase flow, transient flow simulations
  - Fluid mechanics engineering and research
  - Computer programming
  - Mechanical engineering
  - Drilling, completions and workover engineering
  - Reservoir engineering

Theory and Practice

- Olga-Well-Kill combined with 15 years hands-on experience has proven to be a very reliable combination