

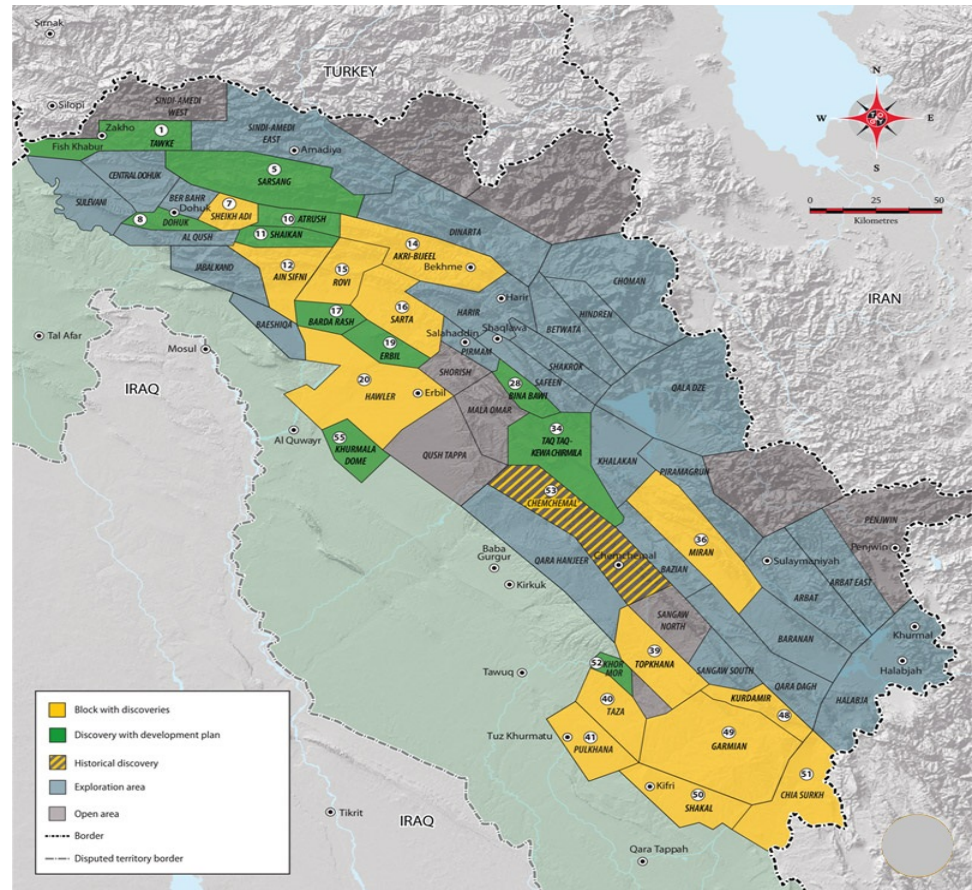


Operations in Kurdistan region, North Iraq

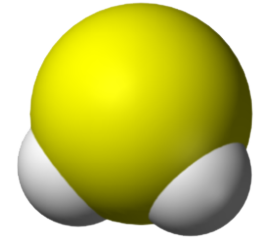
# **SOUR SERVICE ENVIRONMENTS**

## Brief history

- Kurdistan region:
  - Located in North Iraq.
  - Extraction of oil & gas reserves started in 2011, mainly exploration.
  - Currently 21 Operators
  - With 45 billion barrels of estimated oil reserves, the Kurdistan Region is poised to become a key part of Iraq's renaissance and a major player in the world oil markets.
  - As exploration continues, the region has shifted to a development phase. Oil production increased from 75,000 barrels in February 2011 to 200,000 barrels today. The target is to reach 1 million barrels of daily production by 2015



## Drilling Challenges



- H<sub>2</sub>S concentrations up to 30%+
- One of the most critical sour regions in the world
- Chemically unfriendly environment
- Deep wells (typically around 20,000 ft TVD) associated with sour gas environments
- Difficulties in drilling operations frequently leading to well control issues
- Several incidents involving drillstring failures due to H<sub>2</sub>S resulting in major delays in the drilling operations
- On occasion some wells can take at more than 1 year to drill

## H<sub>2</sub>S blow-outs

2 major blow-outs occurred in 2010 due to drill pipe failures under H<sub>2</sub>S presence

Example of a blow-out on a field in the KRG region:

- H<sub>2</sub>S failure in a clients exploration well
- G-105 API drill pipe used in 0.5% min. H<sub>2</sub>S
- Failure at the top of the string:
  - » Failure at 850 m TVD
  - » Bit depth 3,396 m
- Root cause: Sulfide Stress Cracking (SSC)
- Improper grade selection: G-105 instead of Sour Service DP



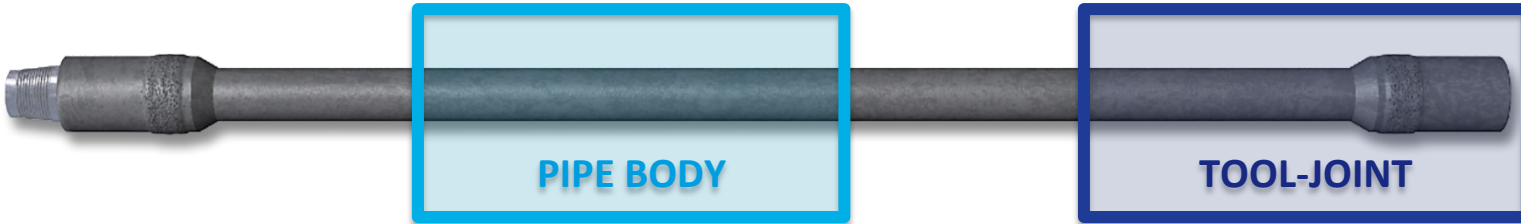


## Solution Provider



- Thanks to a benchmark with other highly sour regions of the world (Canada, Chevron's CDB project in China's Sichuan basin, etc), selection of Drill Pipe grade and double shoulder connection oriented towards IRP Volume 1 products (VM-105 DP SS), and high torque double shoulder connections (VAM EIS, VAM Express).
- Petrostem has progressively ramped up its inventory of DP with compliance to the IRP 1.8 specification, in order to meet the H<sub>2</sub>S challenges faced by operators.
- Technical campaign: several workshops have been co-organized by Petrostem and Vallourec Drilling Products in Erbil, regional capital of Kurdistan, between operators, drilling contractors, inspection companies and the Kurdistan Regional Government's (KRG) Ministry of Natural Resources .
- In-house NACE testing performed on the drill pipe manufactured for the project
- General guidelines for material selection given to operators based on IRP Vol. 1 standard from Canada

## IRP 1.8 Sour Service DP



	Min Yield Strength (SMYS)	NACE test A Tested at %SMYS	Spec Compliance	Min Yield Strength (SMYS)	NACE test A Tested at %SMYS
VM-95 DP SS	95	85%	IRP 1.8	110	110
VM-105 DP SS	105	85%	IRP 1.8	110	110

- Petrostem has a number of VM-105 SS Drill Pipe strings working within the KRG region supporting both Operator and Drilling Contractors alike.



## Product performance

### Successes:

- A client of ours was the first operator to use VM-105 SS Pipe in 2011 in Kurdistan area.
- 5,000 m of VM-105 DP SS pipes were used in 18% H<sub>2</sub>S and underbalanced drilling in there well.
- No SSC failures had been reported throughout the 1 year drilling operation.
- Currently, the large majority of the rigs drilling exploration wells in this part of the world have been equipped with VM1-05 SS Pipe and have ensured safe operations for more than 3 years.



**Successfully supporting and guiding  
the pioneers of North Iraq  
exploration**

## Remaining challenges

- Corrosion issues non-H<sub>2</sub>S related:
  - CO<sub>2</sub> corrosion
  - HCl acid injection in wells when stuck pipe situations



- Pitting corrosion difficult to address with Carbon steels
- HCl injection must be avoided using any steel DP

