Wireline Applied Stimulation Pulsing (WASP®) Technology

New Wells  Producing Wells  Injection Wells  Chemical Treatment  Scale Removal  Open Hole
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Company Overview

Blue Spark was formed in 2011

➢ Service company focus on developing ‘High Pulsed Power’ for oilfield applications.
  ➢ Management & Operational Headquarters in Calgary, Canada
  ➢ Research & Development Centre in Toulouse, France

➢ Technology:
  ➢ Unique wireline-deployed tool for generating shock waves in the well-bore
    ➢ Production stimulation
    ➢ Scale removal

➢ Operations:
  ➢ First commercial operation in September 2011 in Canada
  ➢ First offshore, horizontal operation in June 2013 – North Sea
Key International Customers
High-Pulsed Power technologies convert a low power electrical input into a very high power electrical output for an extremely brief period of time, similar to lightning.
Introduction to High-Pulsed Power
WASP® Applications

New Wells
WASP® reduces formation damage caused by well construction activities such as drilling, cementing and perforating.

Producing Wells
WASP® clears blockages in completion equipment and perforations.

Injection Wells
WASP® increases injectivity and reduces injection pressure.

Chemical Treatment
WASP® improves the effectiveness of chemical treatments by increasing the contact area within the targeted zones.

Scale Removal
WASP® removes insoluble scale from both upper and lower completion equipment.

Open Hole
WASP® generates radial fractures independent of in situ stress.
WASP® Applications: Scale Removal

➢ **Upper Completion**
  - Sub Surface Safety Valves
  - Gas Lift Valves
  - Sliding Sleeves
  - Wellhead Valves

➢ **Lower Completion**
  - Sand Screens
  - Gravel Packs
  - Perforated Liner
  - Slotted Liner
Current Industry Solutions for Conventional Scale Removal

**Mechanical**
- Milling, Brushes, Explosives (string shots)
- Ineffective in perforations & screens
- Risk of damage to completion equipment
- Limited effectiveness in complex profiles

**Chemical**
- Placement (path of least resistance)
- Unintended / undesirable chemical changes
- Corrosion
- Environmental Risk

**Re-Perforating**
- Integrity of completion (screens, poor cement)
- Transportation and handling of explosives
- Effectiveness limited by physical constraints
- Skin associated with crushed zone
Surface Test - Iron Carbonate Scale

- A section of 9-5/8" casing with predominantly Iron Carbonate scale deposit provided by a client.
- After 30 pulses most of the scale was removed.
- After an additional 30 pulses (60 total) the inside of the casing was completely clean.

Attempts to remove scale with a hammer and chisel
Lab Testing: Sub Surface Safety Valve (SSSV)

➢ **Objective:** Evaluate the effectiveness of WASP® to free a SSSV fouled with scale

➢ **Set-up:**
  ➢ TRSSSV was hydraulically opened, cemented in place and allowed to cure
  ➢ WASP® was run through the SSSV at 120 pulses per foot

➢ **Results:**
  ➢ SSSV was fully operational
  ➢ Cleaning the flapper itself requires placement of the WASP® across flapper and then releasing pressure allowing the flow tube to retract and exposing flapper
Case Study: SSSV Scale Removal & Re-Activation

➢ Challenge:
  ➢ Operator determined that a Sub-Surface Safety Valve (SSSV) would not successfully perform a routine inflow pressure test – due to scale build-up
  ➢ Two separate interventions attempted using conventional chemical & mechanical methods

➢ Solution:
  ➢ Operator decided to mobilise Blue Spark’s WASP® technology, with its ability to remove scale from complex downhole completion equipment items - without risking any damage
  ➢ Blue Spark’s WASP® service run on client's preferred wireline provider
  ➢ 3 m (10 feet) interval across the SSSV was treated with WASP® - total operating time was less than 24 hours

➢ Outcome:
  ➢ SSSV was successfully activated and inflow pressure tested - well was handed back to Production.
  ➢ Effective for NUI (normally unmanned installations) with small footprints & challenging lifting restrictions
  ➢ Significant cost saving - well returned to fully compliant integrity status, without the requirement for a workover
Case Study: Scale Removal from WI Vessel

➢ **Challenge:**
   - Operator believed subsea well had potential to be a significant producer.
   - But significant scale present in well, including across HOS and SSSV.
   - Well Intervention Vessel planned to achieve CT & WL intervention work scope.
   - CT milling operation planned to remove scale in the well & return SSSV to operation.
   - CT milling operation not achieved - programme changed to set suspension plug in tubing

➢ **Solution:**
   - Blue Spark WASP® technology selected as preferred solution to treat HOS & SSSV after CT milling.
   - WASP® equipment & Engineer mobilised offshore & deployed with operator’s preferred CT & wireline provider.
   - WASP® treatment performed across section of tubing – total well intervention time – less than 12 hours.

➢ **Outcome:**
   - Scale removed from tubing
   - Suspension plug set – tested successfully
Case Study: Tubing Scale Removal: Workover Operations

➢ Challenge:
  ➢ Major North Sea operator required scale-free sections of tubing for plug set & tubing cut prior to pulling the completion.
  ➢ Objective previously achieved from jack-up rig using Coiled Tubing & jetting technology (fluids & abrasives).

➢ Solution:
  ➢ WASP® deployed on operator’s preferred wireline provider & performed from platform, prior to jack-up arrival on location.
  ➢ Two specific tubing sections treated with WASP® in a single wireline run - total WASP® treatment time less than 4 hours. Results verified by caliper log. Total of 48 hours including wireline rig up/down.

➢ Client Benefits:
  ➢ Reduction of 8 days in jack-up rig time - WASP® operation performed offline.
  ➢ Requirement for Coil Tubing eliminated – mobilisation, rig-up, rig-down, reduced crew.
Case Study: Scale Removal at SCSSV on NUI

➢ Challenge:
  ➢ Operator had failed integrity test on Surface Controlled Subsurface Safety Valve (SCSSV)
  ➢ Well on this Normally Unmanned Installation (NUI) was producing oil at 3,500 bpd
  ➢ Operator believed failure due to Barium Sulphate scale build-up in tubing and at SCSSV
  ➢ Unable to use conventional methods due to scale restriction above SCSSV
  ➢ Operator required to shut-in well and set plug - as barrier - below SCSSV

➢ Solution:
  ➢ Blue Spark WASP® technology selected as preferred solution
  ➢ WASP® equipment & Engineers mobilised offshore & deployed with operator’s preferred wireline provider
  ➢ WASP® treatment performed across the SSSV – total well intervention time – less than 12 hours

➢ Outcome:
  ➢ SCSSV inflow tested – successfully
  ➢ Well back on production

Normally Unmanned Installation (NUI) - Norway
Case Study: Scale Removal at Side Pocket Mandrel

➢ Challenge:
  ➢ A major North Sea operator encountered a leaking SPM with a Gas Lift Valve (GLV) insert, and required to replace it.
  ➢ The Kickover Tool (KOT) was unable to lock in the well-bore or latch onto the GLV, due to Barium Sulphate scale build-up on the SPM/GLV and in the tubing.
  ➢ Brushes, Downhole Jars & Exercise Tools were attempted without success.

➢ Solution:
  ➢ Blue Spark WASP® equipment & Engineer were mobilised offshore at short notice.
  ➢ WASP® toolstring deployed on operator's preferred wireline provider.
  ➢ WASP® treatment was performed across the SPM & also the tubing immediately above and below it.

➢ Outcome:
  ➢ Confirmation that scale was removed from SPM & tubing.
  ➢ LIB was run to verify condition of top of GLV.
  ➢ KOT was re-run and able to latch onto the GLV.
  ➢ Successful pressure test performed on SPM/GLV.
Case Study: Scale Removal at Sand Screen

➢ Challenge:
   ➢ A North Sea Operator suspected that a large section of sand screen across a productive zone was plugged by barium sulphate scale.
   ➢ However, the relatively low production rate, coupled with a small, unmanned production platform, precluded most other intervention solutions.

➢ Solution:
   ➢ An intervention was planned to clean a section of the slotted liner & sand screen.
   ➢ The Wireline Applied Stimulation Pulse (WASP®) tool was deployed using a wireline tractor. The client selected a section of liner to treat with the WASP®

➢ Outcome:
   ➢ Oil production increased to a 3 month average of 250.9 BOPD, nearly a 173% increase.
   ➢ Improved production was sustained for more than 6 months & the Operator chose to maintain the well as a producer, rather than convert it to an injector
WASP® Advantages

Cost Effective
Cheaper than alternative solutions in terms of price, downtime and workover costs

Efficient
Rapid, targeted treatment with minimal impact on operations

Safe
Minimal risk to persons or assets

Green
Energy efficient

Proven
Confirmed results over varied well types, lithologies, completion equipment and production challenges