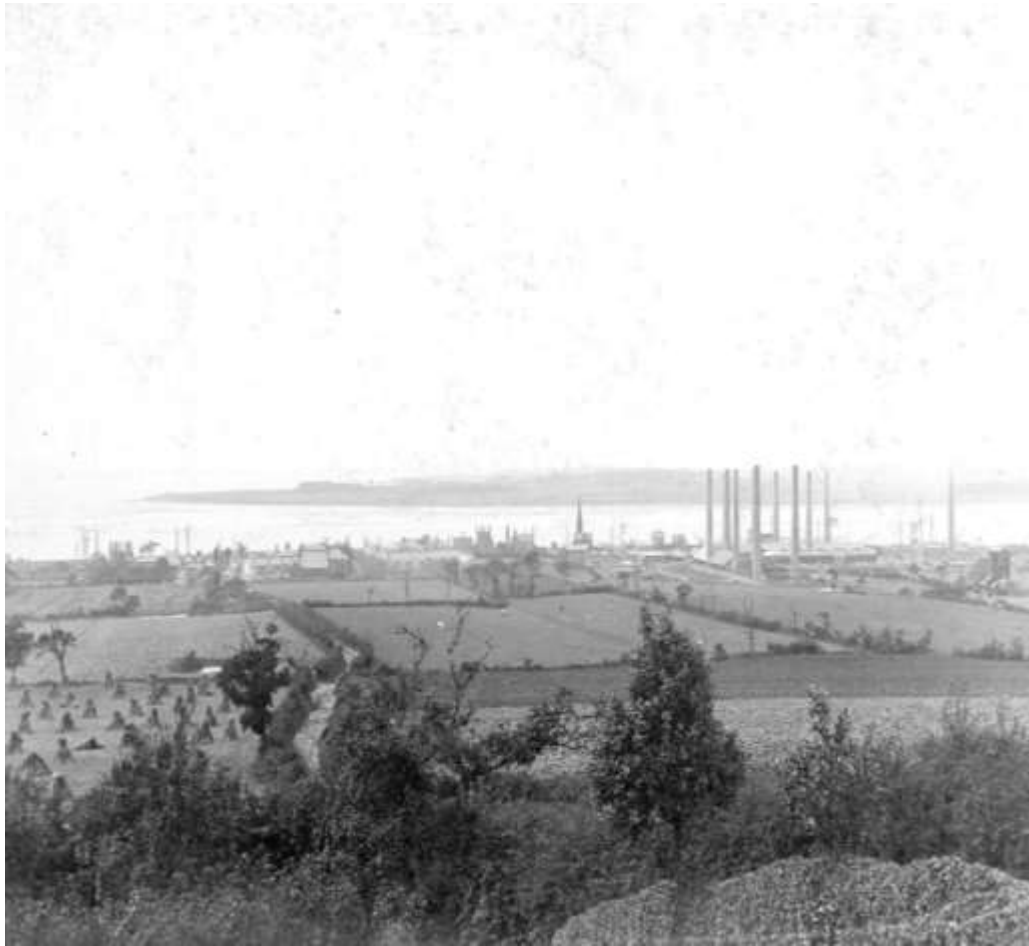

Inovyn Salt Business

High Pressure Water Jetting

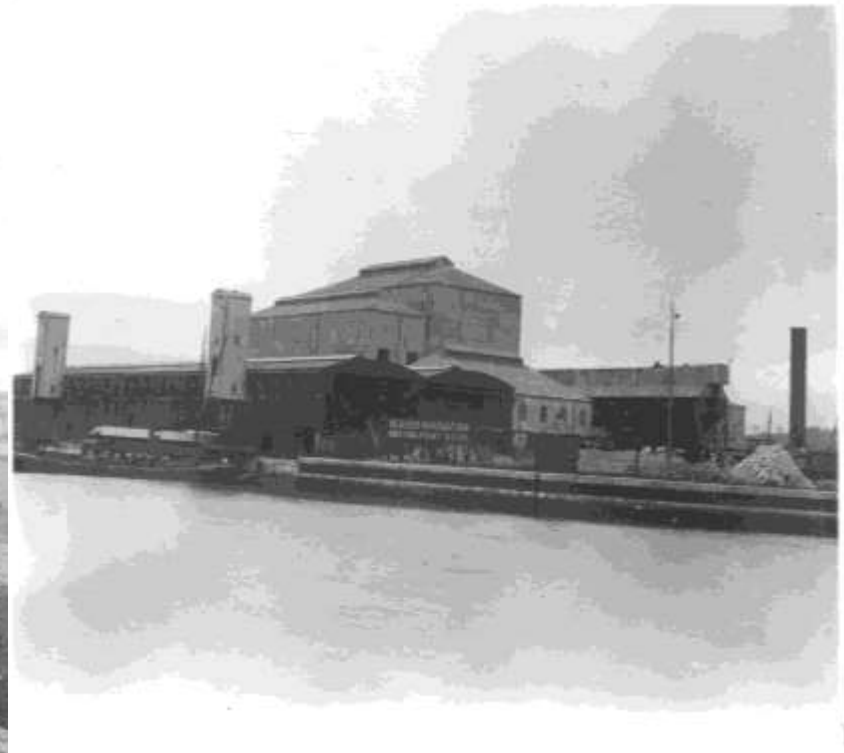


Safety Awards 2019

Inovyn Salt Works, Weston Point, UK Runcorn



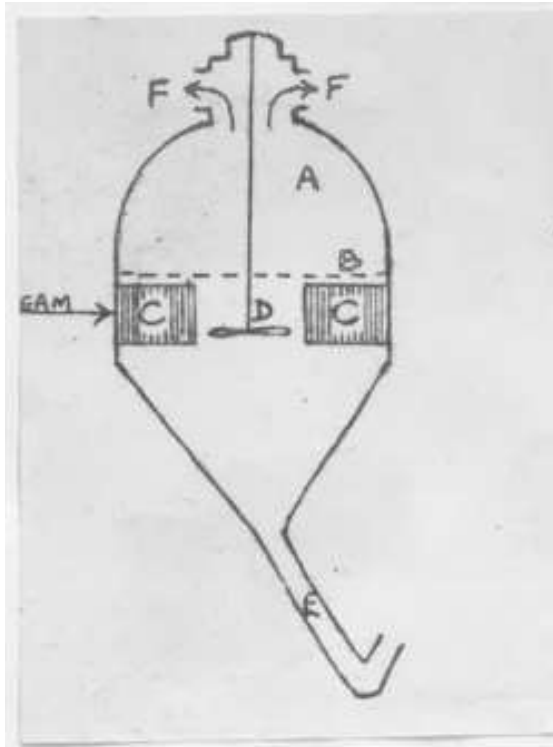
Salt Works in 1895



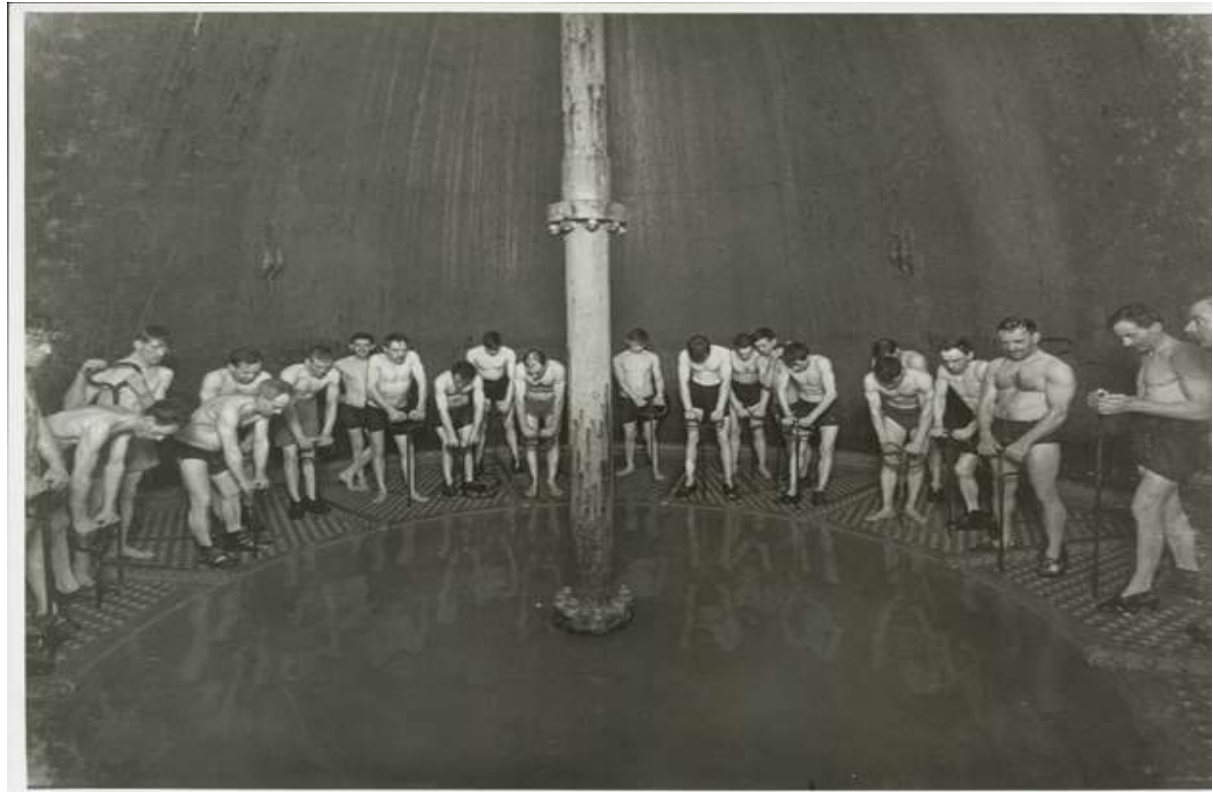
Original Vacuum Evaporation
Plant in 1910

Evaporator Designs

- Original design had internal tubes for heating the brine
- Replaced in the 1950's with external heat exchangers.
- Tubes have always required descaling from hard salt and calcium carbonate.



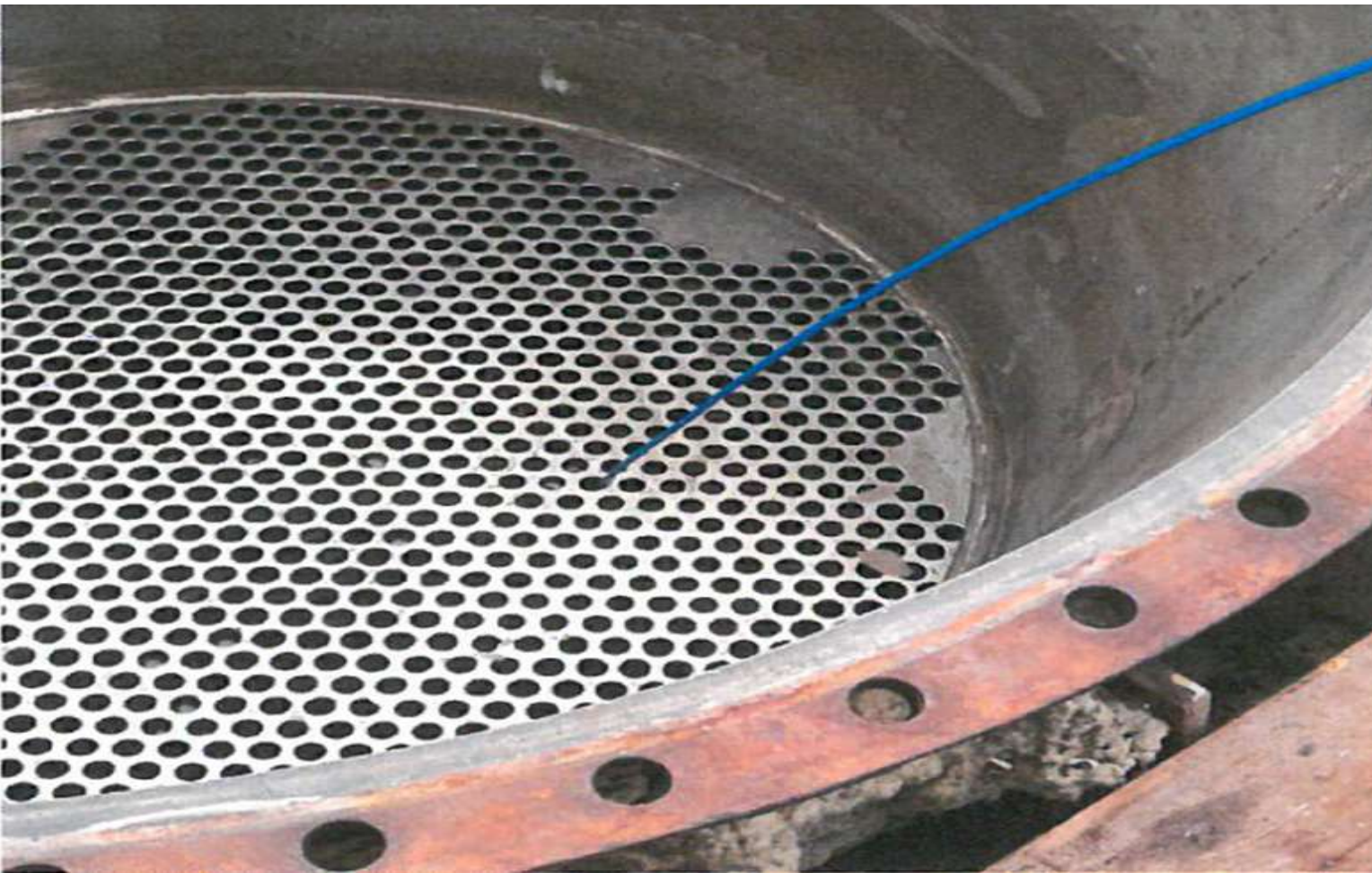
Evaporator 1911 - 1956



Tube Cleaning in 1923

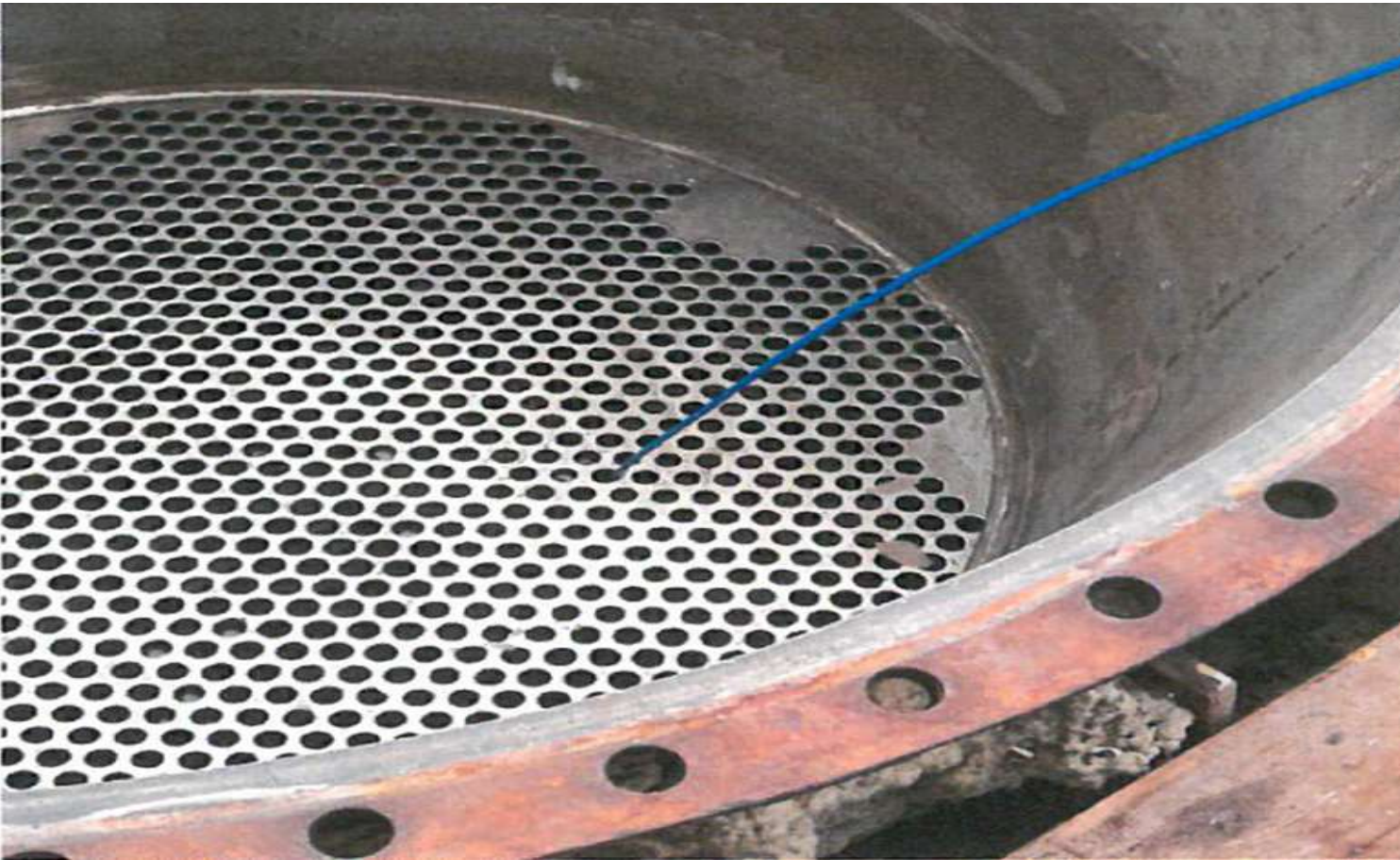
Today's Heat Exchangers

- 8 units with between 800 to 1800 tubes. Tube diameter 25mm.
- High Pressure Water Jetting @ 15,000 PSI / 1000 bar
- Hard salt in the higher temperature vessels historically tough to clear.



Pre 2017 Salt Site Cleaning Technology

- High Pressure Water Jetting @ 15,000 PSI / 1000 bar.
- Cleaned using a plastic high pressure water hose with a cleaning nozzle.
- Operator manually feeds the flex hose into the tubes.
- An externally operated foot pedal controls the pressure on the hose.
- Three person operation.



Incident at Inovyn Salt Business

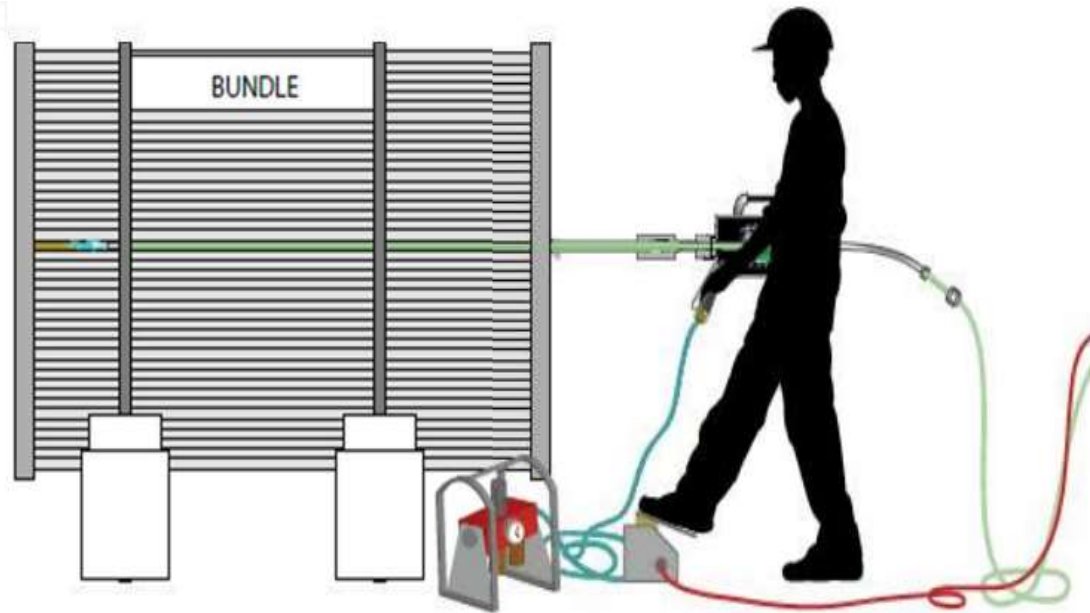
What happened ?

- During cleaning of a tube bundle, the “banshee cutting head” detached from the hose.
- The lance was ejected back up the tube and hit the operator in the face
- Injured party sustained fractured nose.



High Pressure Water Jetting Can be Fatal

- Germany March 2018
- 6m length tubes , 13mm diameter.
- 2 person operation.
- Operator 1 cleaning tubes with lance that had a rotating nozzle on the end of it. A foot pedal valve is used for stopping the high pressure water supply.
- Operator 2 is next to the machine (compressor) on the ground to shut it off in an emergency.



Fatal Incident (Outside INEOS) What happened

- After 2 hours of cleaning the tubes, Operator 1 was struck on the leg by the HP hose nozzle which caused severe internal injuries.
- IP tragically died at the scene.
- Operator 1 had blocked the foot pedal with rags and tape, ensuring the water would not turn off. It is suspected that after extracting the nozzle from a tube he somehow came into contact with it.
- Operator 2 was not observing the job, occupied with other work.

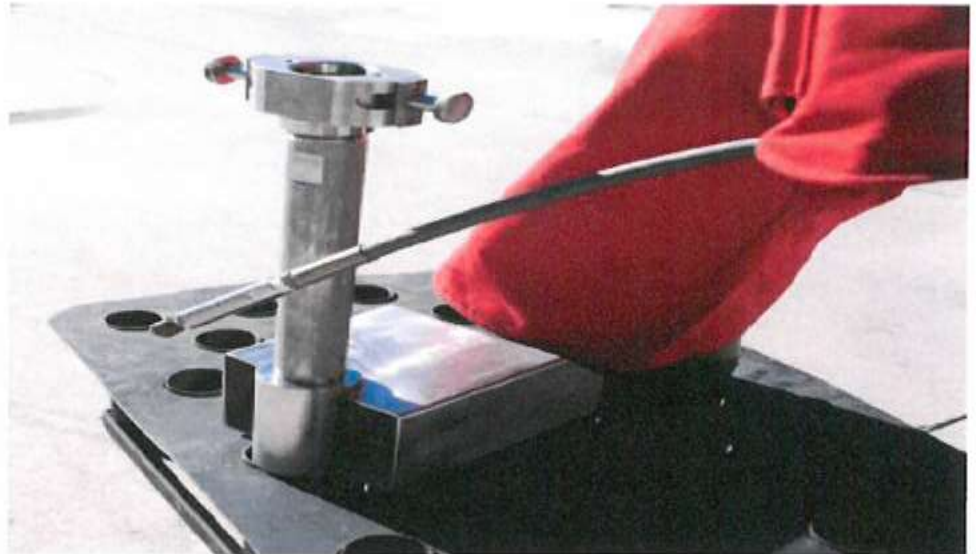


Figure: Demonstration of a technique that was potentially used to block foot pedal

Safety Improvement, Two Stage Progression

Stage 1.

- Anti ejection device used, that fitted over the tubes and prevented the hose / nozzle from being ejected if failure occurred.
- Implemented after the reportable injury at Salt site and forms part of safe systems of work and risk assessments for HPWJ.



Safety Improvement Stage 2

- Semi Automated High Pressure Water Jetting system implemented.
- Anti ejection device system.
- Allows the operator to be outside of the vessel when the HPWJ cleaning of the tubes is in progress.
- Significant reduction in line of fire and injury risks.



Safety Improvement Stage 2 HPWJ Semi Automatic



Safety Improvement Stage 2 HPWJ Semi Automatic



Summary

- Manual Activity
- Risk of injury using equipment
- Injury sustained on Salt site
- Fatal injuries outside INEOS
- Collaborative approach with high pressure water jetting companies
- Significant improvement identified
- No injuries and compliance with Inovyn safety management systems.
- This approach saves lives.