GOM Diving Safety Work Group

COMMITTEE WORK GROUP

Underwater Excavation with

Hand Jetting

July 14, 2015

DISCLAIMER

This US GOM DSWG document is not meant to be all inclusive, and not every rule and regulation is contained herein. The US GOM DSWG does not issue policy or create regulations. The reader should consult additional resources and subject matter experts for more detailed information as required.

Underwater Excavation with Hand Jetting

The GOM Diving Safety Workgroup is a US GOM focused, non-competitive and non-commercial group of oil and gas operators, transmission companies, commercial diving companies, supporting sub-contractors, organizations and industry stake holders. The group will provide a unified voice to promote and improve diving safety, through the following:

- identification and sharing of best practices
- identify and seek solutions to industry challenges and issues
- review and comment of existing and proposed standards and guidelines
- provide input to the regulators and industry associations

Purpose of Committee

This document has been prepared by the US GOM DSWG as guidance for:

The use of Hand Jetting for Underwater Excavation

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The document is divided into seven sections:

- **Part 1: Executive Summary**

- **Part 2: Definition**

  Defines the activity that is being evaluated and provides definitions from regulatory or industry groups that are associated with the activity

- **Part 3: Regulatory and Industry Gap Analysis**

  Identifies regulatory and industry association requirements to perform the activity or operation and provides a visual aid to determine the consistencies between these groups as it relates to the activity

- **Part 4: Past Incidents**

  Identifies past near misses, incidents, and fatalities and provides causal factors and the root cause of the incident in order to provide supporting documentation for the hazard analysis in Part 5

- **Part 5: Hazard Analysis**

  Identifies the hazards of the activity or operation, Identifies the risks associated with the hazards, and provides specific mitigation considerations for each hazard to reduce or eliminate risk

- **Part 6: Drills and Preparation**

  Provide a list of drills that should be performed to prepare the crew members for possible emergency situations

- **Part 7: Appendix**

  Please do not alter the template in order to maintain the consistency of the documents as it relates to other committees; but please add additional documentation, reports, drawings, etc. in this section that may provide more depth or relevant information to the report.

Part 1: Executive Summary of Committee

The use of diver hand jetting underwater can be an effective method of excavation. However, to be conducted safely hand jetting operations require experienced trained personnel, auditable assurance of equipment and careful attention to procedures and methodology.

There are numerous variables and unknowns with diver hand jetting. The type of soil, the amount of debris and the depth of excavation are all variables that affect the safety and efficiency of the operation.

Determining soils type is essential to understanding the integrity of the ditch and in designing the ditch profile. The GOM has a good historical database of soil conditions at various locations. However, on site analysis by the diver and or other means is the best tool for determining ditch integrity. Contained in the appendix is soil testing methods. The accepted slope for divers is for every 1 foot the ditch goes down the ditch should be 3 feet wide.

Contractors should have a policy in place for deep ditch jetting, the deeper the ditch the higher possibility of cave in. Deep ditch policies will include additional jet pump, jet hose and additional personnel.

With the unknown of what is in the ditch the diver has to be prepared to protect him or herself against punctures and lacerations by wearing the proper PPE. In addition, the diver should always wear a hard helmet and not a band mask type helmet. This will decrease the chances of the diver flooding the hat or even worse blowing the hat off his or her head.

Control of the jet pump topside is essential in an emergency situation. If the diver gets into a position where the jet nozzle needs to be immediately shut down topside personnel should have a communication system, with back up, in place to accomplish this. In addition a communication process should be in place when the diver calls for jet pressure and when the diver calls for the jet pressure to be shut down.

The launch and retrieval of the jet hose should be considered when mobilizing a jetting project. If at all possible a mechanical means of launch and retrieval should be supplied

Diver recovery drills should be performed. If they are preformed then when an emergency does happen all personnel are properly prepared to react.

With the above procedures and policies in place diver hand jetting can be performed in a safe and efficient manner.

Part 2: Definition

Underwater excavation though the use of diver hand jetting is performed utilizing high volume low pressure water directed to the diver through a large diameter hose connected to a pipe nozzle that is hand held by the diver. The water jet removes the soil and creates a ditch.

Part 3: Regulatory and Industry GAP Analysis

In the table below, list the different requirements or guidelines from regulatory and industry work groups and complete the GAP analysis by inserting Yes or No to indicate which of the agencies or groups require or allow the action or process.

Item	Description of Item	IMCA	ADCI	USCG	OSHA	Comments
1	Risk Assessment	Yes	Yes	Yes	Yes	IMCA does not address hand jetting but states that all diving tasks have a risk assessment.
2	Jetting Tools	No	Yes	No	No	
3	Ditch Design Criteria	No	Yes	No	Yes	OSHA states trench at bottom cannot be more than 15 ft wide Protective system required for ditches over 5 ft. Over 20 feet deep a PE designed protective system
4	Deep Ditch Policy	No	Yes	No	Yes	ADCI deep ditch over 6', OSHA requires a protective system over 5 ft
5	Rescue Plan and Drills for Jetting	No	Yes	No	No	
6	Minimum Crew Size for Deep Ditch	No	Yes	No	No	
7	Minimum Equipment for Deep Ditch	No	Yes	No	Yes	
8	Specified Slope for Deep Ditch	No	Yes	No	No	Slope is recommended to be minimum 1 to 3. Every foot down the ditch goes outward 3 feet
9	Sonar Required for Deep Ditch	No	No	No	No	Sonar is an extra set of eyes that can monitor the ditch walls
10	Jetting / Working around Live Pipelines	Yes	Yes	Yes	Yes	

Item	Description of Item	IMCA	ADCI	USCG	OSHA	Comments
11	Band Mask not accepted for Jetting	No	Yes	No	No	Full. helmet should always be used
12	Training for Jetting	No	Yes	No	Yes	
13	Procedures for communications and back up communication to jet pump operator	No	No	No	No	In an emergency the jet pump may need to be immediately shut down.
14	Procedures for Pressurizing and Depressurizing jet pump	No	No	No	No	
15	Soil Type Identification	No	No	No	Yes	

Referenced Documents:

OSHA Subpart P, Excavations 29 CFR 1926.650, / 651 / 652
ADCI Consensus Standards 6.1
USCG
CFR 195.424 Pipe Movement

Part 4: Past Incidents

List some past known incident types such as Near misses, incidents, or fatalities and include a root cause if one was determined. This is a representative sample of past incidents and it will aid the committee in Part 5 of this document which identifies hazards with the task or operation associate with this document.

Item	Incident Type (Near Miss / Incident / Fatality)	Description of Event	Root Cause	Comments
1	Fatality	Diver jetting below casino barge in river, trapped under barge. Diver bailed out and drowned.	Inexperienced diver, lack of rescue procedure.	The dive was technically a Penetration dive because of the tight space. Penetration procedures were not followed.
2	Fatality	Diver working in 20' ditch side walls caved in and diver suffocated	Lack of monitoring side walls	
3	Fatality	Diver jetting under riser. Adjacent riser slid into ditch knocking divers hose off his helmet and he drowned	Lack of awareness of work site	Diver recovery drills may have helped
4	Near Miss	Numerous cases of side wall collapse and diver trapped and able to jet himself free	Monitor ditch walls	
5	Incident	Jet nozzle broke apart on bottom injuring diver	Equipment inspection prior to dive	
6	Incident	While diver was jetting he was straddling pipeline and the side wall collapsed breaking his leg	Poor body position, lack of awareness of side walls.	
7	Incident	Numerous cases of puncture or lacerations from bottom debris in mud or falling into ditch	Wear proper PPE – puncture resistant gloves, chaps, etc.	

Item	Incident Type (Near Miss / Incident / Fatality)	Description of Event	Root Cause	Comments
8	Incident	While retrieving jet hose topside personnel injured back.	Proper lifting techniques were not utilized nor mechanical means	Utilize mechanical means to retrieve hose.
9	Incident	Jet hose dewatered and filled with air to retrieve to surface. Hose fouled sat diver	Un safe procedure	Utilize power sheave
10	Incident	Removal of suction hose from jet pump. Individual injured when hammer fitting jumped and hit him in the face.	Un safe procedure	Utilize proper body positon and crane

Part 5: Hazard Analysis

Identify some known and possible hazards to the operation, describe the risk associated with each hazard and provide specific mitigation considerations that could be implemented to reduce or eliminate each risk.

Item	Hazard Identified	Risk Associated with Hazard	Mitigation Considerations (Be Specific)
1	Lack of understanding of the item being jetted.	Item shifts or breaks apart during jetting process and traps or injures diver	Fully understand Item being jetted. Does that item have stored energy?
2	Un seen debris	Injury to diver	In zero visibility debris is difficult or impossible to foresee. Diver experience and proper PPE is the best mitigation.
3	Diver Floods Hat	Diver drowns	Full helmet always used / Diver should be trained in jetting
4	Jet nozzle pressurized before diver ready or not de pressurized when diver calls for it	Uncontrolled jet nozzle injuries diver	Established communication process for pressurizing and depressurizing jet pump
5	Side Wall Cave in	Trapping diver and possible injury or fatality	Monitor side walls, understand soil type. Consider use of Sonar.
6	Jet Nozzle / Jet Hose loss of integrity	Diver Injured	Equipment inspection and testing prior to putting in water
7	Topside personnel injured due to jetting component malfunction	Injury or Fatality	Equipment testing and understanding of pressure boundaries. Utilizing whip checks on all hoses
8	Topside personnel retrieving jet hose	Injury to personnel because of weight of hose	Utilize power sheave, crane or some other mechanical means to retrieve hose. If necessary
9	Diver jetting around area of contaminants such as residual hydrocarbons from a pipeline leak	Possible irritation to diver body and or bell contamination	Pre job planning and understanding of what is to be jetted. Proper PPE if hydrocarbons are expected.

Item	Hazard Identified	Risk Associated with Hazard	Mitigation Considerations (Be Specific)
10	Diver does not de pressurize nozzle before leaving bottom	Jet nozzle will bury itself	Always de pressurized jet nozzle before leaving bottom
11	Jet pump diesel runs away.	Emergency shutdown always in place	Test emergency shut down
12	Soil will not hold ditch walls	Perform manual or mechanical soil test prior to excavation. Increase slope	There are excellent easy manual soil testing procedures
13	Tunneling	Entrapment	Diver consistently confirms by going to top of ditch that there is no tunneling

Part 6: Drills and Preparation

Provide a list of drills that should be performed to familiarize the crew with possible risks and hazards and provide specific preparations that can be made to reduce risk. Attach the drills if provided in the Appendix.

Item	Drill Name	Describe Drill
1	Trapped Diver Hose Recovery	Diver's hose is trapped after a cave in. Standby diver will dress in, standby jet hose and jet pump will be readied. Standby diver will follow divers hose to bottom and determine best course of action to free hose. Diver has no physical injuries.
2	Trapped Diver Recovery with physical injuries	Diver is trapped after cave in. Diver is conscious but has physical injuries which will prevent him from ascending on his own. Standby diver will dress in; topside will ready the Standby jet pump and hose. Standby diver will follow divers hose to bottom and determine best course of action to free diver. Standby diver will have to assist diver to the surface and into DDC if decompression is required.
3	Trapped Diver recovery with Unconscious Diver	Diver is trapped after cave in. Diver is unconscious and has physical injuries which will prevent him from ascending on his own. Standby diver will dress in; topside will ready the standby jet pump and hose. Standby diver will follow divers hose to bottom and determine best course of action to free diver. Standby diver will have to retrieve diver to the surface and into DDC if decompression is required.
4	Emergency Shut Down of Jet Pump	Dive supervisor will notify deck crew to shut down jet pump. The time to shut down should be no more than 15 seconds

Part 7: Appendix

Insert additional documentation, reports, drawings, etc. in this section that may provide more depth or relevant information to the report. List additional material in table and attach original to the back of this report.

Item	Appendix Item	Description of Item
1	Drawing	Soil Classification and Testing A Technip document

Appendix #1

Soil Types

The type of soil influences the stability of a trench. In order for a soil to be classified, a mechanical test or one visual and one manual test should be performed by a competent person. OSHA identifies soil types as the following:

Soil Type A-
Most stable: clay, silty clay and hardpan. Compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of this type of soil are clays, silty clay, sandy clay and clay loam. A soil is not type A if it has been previously disturbed or water is present.

Soil Type B-
Medium stability: silt, sandy loam, medium clay, previously disturbed soils and unstable rock. Compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)

Soil Type C-
Least stable: gravel, loamy sand, soft clay, cohesive soil with unconfined compression strength of .5 tsf (48 kPa) or less. Wet soils are in this category.

Soil Tests

Visual Test
Look at soil particle size and type. You'll see a mixture of different types.
Cracks in wall and spalling can mean soil types B or C.

Manual Test
Sedimentation Test determines how much silt and clay are in sandy soil. Saturated soil is placed in a straight sided jar with about 5 inches of water. After the sample is thoroughly mixed and allowed to settle the percentage of sand is visible. A sample with 80% sand will be classified Type C.

Thumb Penetration
The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with great effort. Type C soils with a confined compressive strength of .5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on undisturbed soil sample such as a large clump of spoil.

Mechanical Test
Tools are available (Penetrometer) to test soils