Stichting Werken onder Overdruk

SWOD

WORKING CONDITIONS CATALOGUE
Working under Hyperbaric Conditions

Information Note Diving No. 1
Risks and control measures of differential pressure (Delta P)

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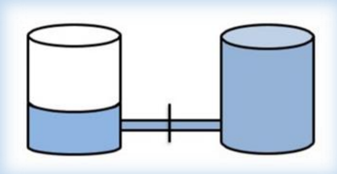
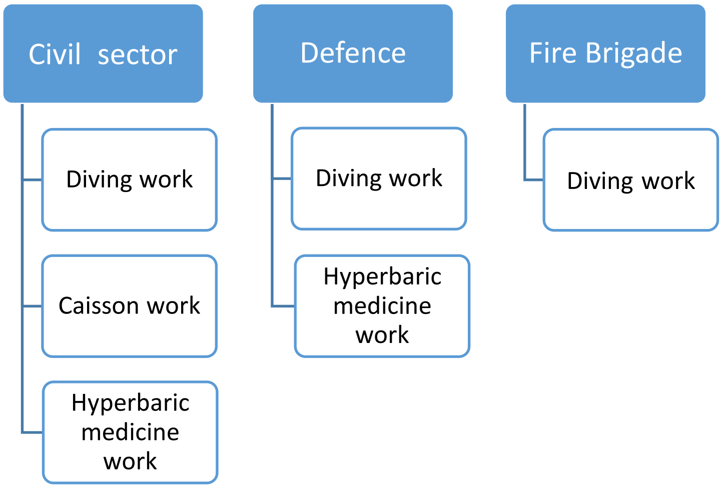


Preface

The Foundation Working under Hyperbaric Conditions -SWOD for short- represents the three fields of activity: diving work, caisson work and work hyperbaric medicine within the three sub-sectors: Defense, Fire Brigade and the Civil sector in the field of Working Conditions.



The Diving Information Note No. 1 “Risks and Control Measures of Differential Pressure (Delta P)” is based on guidelines and information from the diving industry in various countries, as well as from the Dutch diving industry and employee organization.
This information note was approved by the SWOD Central College of Experts (CCvD) on 23rd June and is in force from 1st October 2020

Disclaimer
Although the Diving Information Note No. 1 “Risks and Control Measures of Differential Pressure (Delta P)” has been compiled with the greatest possible care, the Foundation Working under Hyperbaric Conditions, neither the website manager, nor the authors accept liability for any incorrect data and the possible consequences thereof.

If any questions arise concerning the accuracy of the requirements in this Information Note No. 1, please refer to the Dutch version of this document, which is the official version.

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1 TERMS AND DEFINITIONS

ADC	Association of Diving Contractors (UK & Ireland).
ALARP	As low as reasonably practicable.
AODC	Association of Offshore Diving Contractors (nowadays part of IMCA).
Barrier	A physical separation between two water bodies.
Delta P	Differential Pressure. Also named positive and negative pressure (IMCA)
DPDZ	Differential Pressure Danger Zone is the area of uncontrollable water flow, suction or turbulence (whether created naturally or produced by the operation or failure of machinery and equipment).
DP	Dynamic Positioning. A computer system including reference systems that automatically monitors and maintains the desired position and course of a ship, by means of the propulsion systems.
IMCA	International Marine Contractors Association.
LMRA	Last Minute Risk Analysis. The LMRA is performed at the workplace prior to the work to determine whether previously assessed risks and measures match the situation at the workplace and may need to be adjusted (management of change).
Lockout - Tagout (LoTo)	Lockout-Tagout (LoTo) A safety procedure in which machines, pumps and other power sources are switched off during maintenance and repair work. This procedure is intended to ensure that personnel are protected against the risks of machines, pumps and other forms of energy that can be switched on unexpectedly.
Project RI&E	An RI&E performed for a specific project by the diving contractor, client and competent persons .
RI&E	Risk Inventory and Evaluation (RI&E); every company with personnel must have a health and safety service or health and safety expert assess whether and how the work can be dangerous or unhealthy for employees. This must be recorded in writing. This RI&E must also include a Plan of Action (PVA). It describes which measures an employer will take to tackle the identified risks.
ROV	Remotely Operated Vehicle (ROV), is an underwater robot that can be controlled remotely.
Propulsion installation	The entire mechanical positioning and / or propulsion installation such as, for example, propeller- , thrusters-, jet- and voith systems.
Work plan	Description of project specific tasks and risks.

2 INTRODUCTION

This SWOD Information Note No.1 is part of a series of information notes. The purpose of these information notes is to create awareness of potential risks associated with differential pressure diving.

Compared to other diving activities, diving with differential pressures has a higher risk of fatal diving accidents. Unsafe situations, incidents and accidents caused by moving propellers and water jets on ships are almost always fatal. (See also section 8: References in this document with links to examples of Delta P risks)

By emphasizing the risks and thereby providing guidelines on methods to assess and manage these risks as well as possible, the risks of diving with differential pressures can be reduced or even eliminated.

3 RISKS OF DELTA P

3.1 GENERATED FORCES DUE TO DIFFERENTIAL PRESSURES

We know that liquid is not compressible. Moving water also has a direct effect on the environment under water and therefore also on a diver present in it. The forces that are released do not necessarily have to be great to have a (large) effect on the diver. This includes inlet and discharge channels from vessels, industry, offshore platforms, FPSOs, drilling platforms, work islands, pumping stations, infrastructure works, power plants, sewage installations, but also propulsion and positioning installations.

When a diver approaches an (inlet)opening, a life-threatening situation can occur if the diver is sucked against or sucked into it. In such situations, the forces on the body can be very high, the diver can lose control of his respiratory protection, become disoriented, become trapped or entangled, and become without breathing air because of empty cylinder (s). In recent decades, divers have suffered serious injuries or have died from Delta P incidents. Consider, for example, removing a temporary seal or opening a pipeline whereby they were then sucked into the pipe

Fatal hazards to divers from water flow at differential pressures arise as follows:
The movement of water as a result of differential pressure such as, for example, level differences in water levels. The force generated between two water bodies depends on the height difference between the water levels and the size of each opening in the barrier. What is often not recognized is that very significant (suction) forces can also be created when a modest difference in water level is combined with a relatively large opening.

An active process of water displacement involving a (mechanical) installation or parts thereof. Think of examples such as pumps, valves and propulsion systems. This can be the result, for example, of an operating error, malfunction or insufficient securing of the installation during diving activities.

3.2 (UN-)FAMILIARITY WITH THE RISKS RELATED TO DELTA P

Risks as a result of differential pressure can arise because of:

- A diver without a reference point (sight) will not perceive the displacement due to current (and if detected it is often too late);
- Divers, diving supervisors and other involved personnel are not aware of
    - a differential pressure situation;
    - the correct location where this is located;
    - the strength of the current;
- Operating errors are made, automated systems are used and there is insufficient assurance of disconnection with regards to the safety of diving work;
- There is insufficient knowledge of the risks.

Figure 1: Diving work on pipes

4 LOCATIONS: HAZARDS AND RISKS OF DELTA P

4.1 WHERE CAN WE EXPECT DELTA P ?

Delta P features in, but is not limited to:

- Inlets, chambers, scuppers and other hollow structures in:
  - infrastructure works such as dams, dykes, locks, weirs, water reservoirs;
  - swimming pools / diving towers;
  - (cooling) water and / or firefighting pumps;
  - Hydroelectric power stations;
  - treatment plants, sewage systems (overflow in case of heavy rainfall);
  - desalination installations and other installations.

- Inlets and propeller installations of ships and work islands:
  - propulsion installations (propeller-, voithschneider- or waterjet systems);
  - positioning installations (propellers and thrusters);
  - (cooling) water and / or fire pumps.

- Offshore platforms, FPSOs and drilling platforms:
  - (cooling) water and / or fire pumps.

- Subsea installations and pipelines.

4.2 TYPES OF DANGER OF DELTA P

Differential pressures can be divided into four types:

1. Water is drawn in mechanically to propulsion installations on ships or work islands.
2. The water levels on both sides of adjacent areas vary (for example at dams, dykes, lock gates and water reservoirs).
3. A completely or partially submerged hollow structure filled with a gas (including air) that has a higher or lower pressure than the surrounding water. Examples include subsea installations, submarine pipelines and other underwater structures with hollow components (for example, sunken ships, hollow legs, etc.).
4. Water is drawn in mechanically through inlets (for example, inlets for (cooling) water and fire pumps on land and on offshore platforms, FPSOs, drilling platforms, circulation pumps in swimming pools and diving towers and inlets on ships and work islands).

Figure 2: Construction work underwater

4.2.1 Examples of common situations

Figure 3: Strong currents due to different waterlevels

Figure 4: Features at the surface showing presence of currents

Figure 5: Weir in a river (Hagestein(NL))

Figure 6: Diving activities near a ships propeller

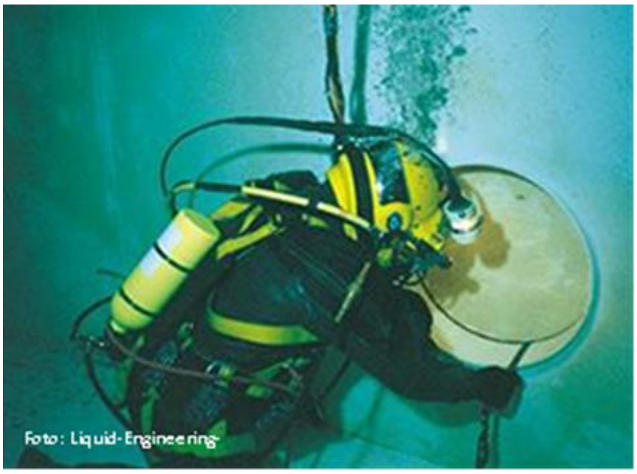

Figure 7: Diving activities near an Inlet/outlet

5 DELTA P: SPECIFIC FEATURES AND DANGERS

Some features and dangers are:

- Differential pressures can occur at all water depths.
- Divers can rarely detect a differential pressure hazard (current) underwater in time to avoid it. Once in a Differential Pressure Danger Zone (DPDZ) it is very difficult for divers to escape the suction forces. Removal of the differential pressure is usually necessary before divers can be released (see Figure 8 below).
- Divers who go into the water to attempt a rescue, to free the trapped diver, risk being injured or killed themselves.
- Differential pressure dangers are often fatal and do not provide an opportunity for effective intervention by rescuers.
- Attempts by surface rescuers to free a diver with brute force prior to removing the differential pressure often result in further injuries to the trapped diver.

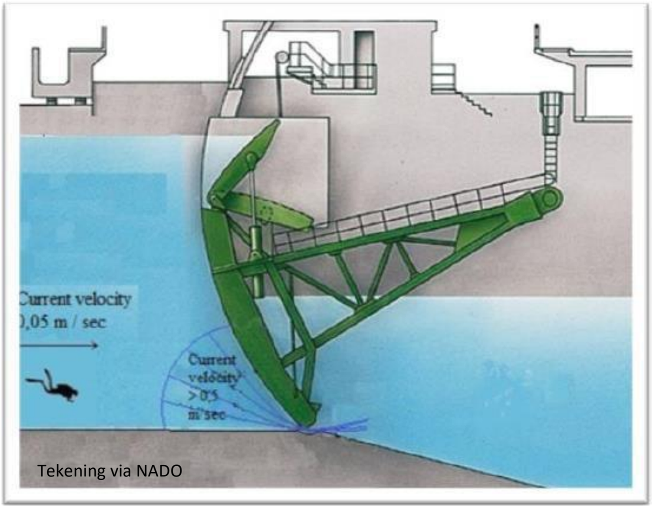

Figure 8 Cross-section of weir with example of flow variations under water

5.1 WATER DRAWN IN MECHANICALLY

When divers have to work near or on a ship, this can involve high risks such as currents at inlets and outlets, rotating fixed propellers, rotating shafts driving the propellers, rotating propellers (Azimuth) and rotating propellers for lateral movement of the ship.

There are also ships powered by water jets that pose a risk when these are activated. (See also ADC GP 001 of IMCA Information Note D 13-09 "Diving on or near vessels and isolating machinery systems" and APPENDIX 2 DELTA P: Isolation of ship engine systems during diving activities from, on or near ships).

5.2 INLETS AND LOCKS, WEIRS AND SHIPS

Locks, weirs and ships are equipped with various inlets and outlets. The inlets and outlets are under water at various locations, depending on the function of the inlet channel. Consider, for example, cooling, displacement (water jet) and water intake (pump). The danger is that the diver is sucked into a channel or is sucked against a grate so that he/ she can no longer move, with or without a major physical impact.

When working on or in the vicinity of inlets and outlets (for example cleaning work), a number of precautions must be taken as indicated in APPENDIX 2.

Figure 9: example of a ship with various risk areas such as; propeller installations for (A) propulsion and (B) positioning and (C) pump inlets

Foto: Wärtsilä

5.3 PROPULSION MEANS BY MEANS OF WATERJETS AND SCREWS

These propulsion means can be located at different locations under a ship. When a diver comes into contact with a rotating propeller or a water jet (mechanical impact), this can be fatal.

Figure 10: Example of a Propulsion system

Figure 11: Propulsion through Waterjet's systems

When working on or in the vicinity of water jets and / or propellers, a number of precautions must be taken as indicated in APPENDIX 2.

When diving from a Dynamic Positioned (DP) vessel, the length of the diver's umbilical must be such that he/ she cannot come closer than 5 meters to the nearest propeller (see Working Conditions Catalogue and IMCA D 010). The length of the umbilical of the standby diver must be 2 meters longer than that of the diver.

5.4 Some examples of Delta P Risks:

On the internet are two You Tube videos that provice a very clear illustration of examples of Delta P risks:

1) https://www.youtube.com/watch?v=AMHwri8TtNE

2) https://www.youtube.com/watch?v=AEtbFm_CjE0&feature=youtu.be

Figure 12: Example of how a crab was sucked into a pipe during cutting activities by an ROV (See video clip 1)

Figure 13: Risks of Delta P activities (See video clip 2)

Figure 14: Possible Consequences of Delta P (see video clip 2)

Figure 5: Risks of Delta P in a swimming pool (See video clip 2)

Figure 16: Risks of Delta P near an inlet (See video clip 2)

6 PREVENTION AND CONTROL OF DELTA P RISKS

6.1 6.1 Responsibilities of the client

It is up to the client who wishes to have work carried out by a diving company to inform the diving company of all known above and underwater parts that may pose a danger to the diving team. This takes place before the Work plan is drawn up and the project RI&E is carried out. Any changes must also be communicated immediately.

6.2 Project RI&E and Work plan

When carrying out a project RI&E , it must be assumed that there is a danger of differential pressure when working in, on or in the vicinity of:

- two adjacent areas where the water levels (may) differ;
- cavities, pipelines and subsea installations;
- inlets where water can be mechanically sucked in by offshore platforms, FPSOs, oil rigs, work platforms, ship and / or shore installations;
- ships and other vessels which may draw in water mechanically to propulsion and positioning installations.

Competent persons should be involved during the preparation of the Work plan by the diving company . Think of onsite supervisors and area competent persons and the client. In the Work plan, project specific tasks, responsibilities, authorities and the results of the project RI&E and the control points of an LMRA are recorded.

If the failure of a measure is a possibility , for example a temporary construction to protect the diver (see AODC 055 Protection of water intake points for diver safety), then this must also be part of the project RI&E .

It is also necessary to determine the size of the DPDZ, including the forces and currents. Formulas to calculate these are included in an HSE diving document (see Differential pressure hazards in diving, RR 761, section 6 and Annex F).

Examples of methods for determining whether there is a risk of DPDZ are:

- visible signs on the surface;
- ROV inspection;
- inspection of construction drawings where inlets are located, pump capacities and obstructions present;
- discussion with the (on site) competent person who is familiar with the location / ship;
- doppler current profiler inspection;
- determine the presence of flow by means of sounding lead;
- monitoring shipping traffic and movements.

Foto: Wärtsilä

Figure 17: Example of propeller (+ 7,5 meter)

If you have to work with a Lockout-Tagout (LOTO) system, this must be included in the Work plan. Locking methods must be used to prevent pumps / other mechanical suction devices from being started / opened during the diving work.

Applications of this method are closing with a lock, removing fuses in a switch box or another safe method and the statement “divers in the water” (Ref: EU Work Equipment Directive (2009/104 / EC) and Working Conditions Decree chapter 7). See also APPENDIX 2.

Figure 18: Example of a locking system with the possibility of attaching multiple locks

Figure 19: Example of Notification label.

6.3 Risk management

Because it is difficult for the diver to detect current (Delta P) during the diving work (nor can estimate pressure differences), these must be estimated and limited as much as possible in advance (project RI&E). Try to limit the danger as much as possible at the source and, if that is not possible, use a different tactic. Wherever possible, remove the pressure difference by, for example, equalizing the water levels, filling the empty spaces with water or have the diver approach the working location from the downstream side (downstream / low side). It may also be possible that a diver can be protected by working from a cage construction.

Figure 20: Diving activities near a propeller

If the differential pressure cannot be avoided at all and the work has to be carried out from the high (upstream) side, measures must be taken to minimize the risks (ALARP). This to prevent the diver from entering the DPDZ.

Figure 21: Utilizing a ROV near a propeller

As a result of the risk analysis, it may be necessary to choose an alternative other than work with a diver, for example by using an ROV**.**

Figure 22: Clocked inlet

The diver must also remain alert that his activities may have consequences for a Delta P. Think of cleaning this grate where the holes have now mainly grown closed and there is virtually no flow. During the cleaning of the grate with a Delta P the flow will increase, if the pump is not switched off or the valves leak, with the associated risks.

The same also applies when clearing a blockage. Here too, a Delta P will increase the flow with the associated risks.

Figure 23: Example of a severe blocked pipeline

6.3.1 The maximum current for a diver during diving activities

In general, a maximum of 0.5 m/sec is maintained. Depending on the circumstances where work is being performed, the LMRA should determine whether it is safe for the diver. The feedback of the diver at the underwater workplace must also be taken into account. (Ref. AODC 047 “Effects of underwater currents on diver's performance & safety”.

6.3.2 Isolation of a diver from DPDZ

To prevent the diver from entering the DPDZ, the following measures can amongst others be taken:

- Limitation of the length of the length of the umbilical or signal line to be issued;
- Use a (temporary) construction of bars or screens, a cage or valve (s) so that the diver stays in the safety zone (where the current is not stronger than 0.5 m / s) which prevents the diver from getting trapped;
- Use a flow meter if possible;
- Where possible, use double water or flow barriers such as e.g. double executed, valves, shut-off valves and gates;
- Take precautions when working on pipes and hollow spaces completely or partially filled with gas;
- Take precautions when working on and near ships (see also APPENDIX 2);
- Only perform airlift operations with under and above water operation.

6.3.3 Pipes and cavities wholly or partly filled with gas

Working on submerged or partially submerged hollow structures containing a gas at a lower and also at a higher pressure than the surrounding water pose a major risk to divers.

The following measures can be taken, among others:

- Use extra or double gates or valves where possible;
- Do not allow the diver to work on a seal that must prevent an inflow / outflow at that time;
- Install shut-off valves to fill an empty or partially empty pipe or hollow space in a controlled manner and install a 'diffuser' to prevent a diver from being trapped (See figure 24);
- Do not attempt to remove a seal from a pipe filled, in whole or in part, with a gas (See figure 25);
- Do not position divers in front of the inlet of a valve when it is being opened (Never check a flow by hand!);
- Have an ROV observed whenever possible when filling a pipe or hollow space;
- When cutting a pipe do not assume that it is filled with a liquid and check the situation and condition of the pipe. A small opening in an empty or partially filled pipe can cause serious injuries;
- When work has to be carried out on a subsea installation, ensure that adequate isolation is provided to prevent injury and environmental pollution (See IMCA D 044).

Figure 24: A diffuser that can prevent a diver from getting trapped

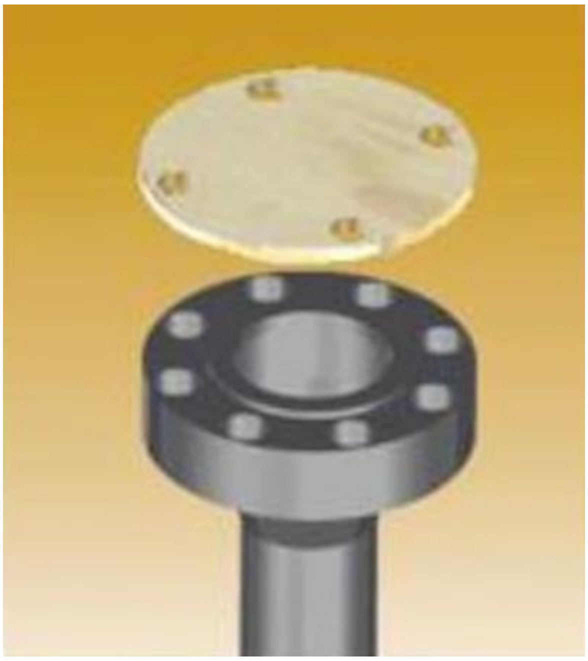

Figure 25: An example of a wooden seal that can pose a serious danger to the diver as there are no provisions to allow the pipe to fill up in a controlled manner and thus prevent the diver from getting trapped

6.3.4 Changes of the scope of work

If the Work plan or work situation changes: carry out the project RI&E again with all parties involved. Document this in a modified Work plan (Management of Change), then communicate this with the operational staff.
(See also Appendix 1)

Figure 26: During maintenance it is possible that other actions than planned are necessary

7 MEASURES TO BE TAKEN PRIOR AND DURING DIVING ACTIVITIES

1. Check with the parties involved, familiar with the relevant work location, whether all safety measures (including Lockout and Tagout) that have been laid down in the project RI&E and in the Work plan have also been taken and record (See also APPENDIX 1 and 2).

2. If possible, measure the current , at and near the location where the diver must work.
3. Discuss with the diving team and other personnel involved the risk of any potential danger at the work site, such as inlets and outlets, propellers, water jets and pump installation, and any passing shipping traffic.

4. Discuss the emergency scenarios and the actions to take if unexpected events occur.

5. Provide all involved personnel with the necessary information to allow the work to proceed safely.

6. Check that the control measures are effective before the start of the diving work.

7. Use SSE to carry out the work or other diving method after making a detailed project RI&E .

8. Apply a work permit / permit to dive system and check that measures have been taken to prevent pumps or other mechanical suction devices from being started and / or opened during the work.
   Examples include closing with a lock, removing fuses or another safe method and visibly placing the "divers in the water" warning (See also APPENDIX 2).

9. Use pre-installed means to prevent suction from differential pressures.

10. Perform a Last Minute Risk Analysis (LMRA) before the diver enters the water.

11. When changing the Work plan or work situation: adjust the Work plan and carry out a project RI&E again with all parties involved (Management of Change Procedure). Then communicate this to the operating personnel (See also APPENDIX 1)

8 REFERENCES

Various documents, websites and YouTube videos about Delta P have been studied when writing this information note and are listed below. It is strongly recommended to also study this information:

1. **UK Health &Safety Executive (UK HSE)**
   http://www.hse.gov.uk/pubns/diveindx.htm

2. **Diving Information Sheet No. 13:**
   Differential pressure hazards in diving

3. **UKHSE research report:**
   RR761 - Differential pressure hazards in diving http://www.hse.gov.uk/research/rrhtm/rr761.htm

4. **ADCI**
   Association of Diving Contractors International (ADCI) video on the dangers of differential pressure: http://videos.adc-int.org/dangers-of-delta-p

   http://videos.adc-int.org/expanded-approach-to-calculating-the-effects-of-differential-pressure- delta-p-on-working-divers

5. **Ontario Ministry of Labour**
   Video produced by the Ontario Ministry of Labour, this video talks about the hazards of Delta P around dams (Courtesy Ontario Ministry of Labour. 2011
   https://www.youtube.com/watch?v=7yEmC-z-dRU

6. **Delta P in Diving -Risks and Prevention (Francis Hermans)**
   https://www.academia.edu/36102784/Delta_P_in_Diving_-Risks_and_Prevention

7. **ADC**

8. **ADC- GP -001**
   https://www.imca-int.com/briefing/975/diving-from-on-or-in-close-proximity-to-merchant-vessels- protocol-for-isolating-machinery-systems-new-industry-guidance-published/ (IMCA Information Note D 13-09 Diving on or near vessels and isolating machinery systems)

9. **ADC-GP-002** Identification, Assessment, and control of differential pressure hazards.

10. **IMCA**

    - **AODC 055** Protection of water intake points for diver safety

    - **AODC 047** Effects of underwater currents on diver’s performance & safety

    - **IMCA D 044** Guidelines for Isolation and Intervention: Diver access to Subsea Systems

APPENDIX 1: EXAMPLE STEP-BY-STEP PLAN FOR DIVING ACTIVITIES AT DELTA P CIRCUMSTANCES

Step	Actors	Action
1	Diving Company Diving Supervisor Site Supervisor Client	**1A/** Project RI&E and Work plan: ⟹ Carry out and agree with all involved parties **1B/** Management of Change procedure: ⟹ adjust Work plan and carry out project RI&E
		Werk location
2	Diving supervisor	LMRA prior starting the work e.g.: ✓ Weather situation and forecast ✓ Water flow rate ✓ Other activities in the area ✓ Safe work location ✓ Suitable Work Equipment and breathing gas ✓ Personnel certified and experienced ✓ Communication and emergency communication ✓ Emergency facilities to rescue diver • Results LMRA: V Workconditions in accordance with Work plan ⟹ *continue with step 3* ✖ Workconditions **NOT** in accordance with Work plan ⟹ *go back to step 1B*
3	Diving supervisor	Discussion Work plan and dangers Delta P with divers, client and site supervisor
4	Diving supervisor Site Supervisor	Work permit (written approval) for diving activities
5	Diving supervisor Site Supervisor	Apply Lock out Tag out procedure and verify
6	Diving supervisor Site Supervisor	Install safety provisions according to the Work plan
7	Diving supervisor	Isolate diver from Differential Pressure Danger Zone (DPDZ)
8	Diving supervisor	Discuss diveplan diver with the diving team
9	Diver	**Execution Work plan:** V No deviations from Work plan during diving activities ⟹ *continue with step 10* ✖ Deviations from Work plan during diving activities ⟹ *go back to step 1B*
10	Diving supervisor	Control during work above and underwater
11	Diving supervisor	When request for extra work ⟹ *go back to step 1B*
12	Diving supervisor	Job completed: Cancel Work permit / written approval for diving activities
13	Diving supervisor Site Supervisor	Resume diving activities after leaving dive site ⟹ ***go back to step 2***

APPENDIX 2 DELTA P: ISOLATION OF SHIP ENGINE SYSTEMS DURING DIVING ACTIVITIES FROM , ON OR NEAR SHIPS

Short overview of: ADC-GP—001 Aug. (09) Guidance Procedure Diving From, On or In Close Proximity to Merchant Vessels

Diving from, on or near ships - Overview of general recommendations

The following is an overview of general recommendations for ship operators / crews and for diving companies:

1. When there is a risk of serious injury or death from remote start-up of machinery, safe isolation should be provided, lockable isolation methods are the most robust / reliable and should be used where possible (See, for example, Figure 18 in this information note)
2. A formal "Permit-to-Dive" system must be in place specifying the relevant isolations and strictly adhered to.
3. The Captain, Chief Engineer Officer and Dive Supervisor must sign the Permit-to-Dive.

Important: If the captain and chief engineer are not on watch and asleep, officers who will officially replace the captain and chief engineer must sign the Permit-to-Dive

1. All personnel on the bridge and in the engine room must be informed of the planned diving operations and the vessel's PA system must announce the start and end of diving operations.
2. Relevant warning signs indicating that the divers are at work should be posted at all control points where machines dangerous to divers can be started / turned on (see example in Figure 19 in this information note).
3. Whenever possible, the machines should be locked. When using locking systems / pliers, the dive supervisor must attach his own padlocks and keep the keys for these padlocks.
4. When it is not possible to use “lock-off” isolation methods, members of the diving team can be watchmen on the bridge and in the engine room (or at other control points where machinery dangerous to a diver can be operated) placed for the specific purpose of preventing dangerous machines from being operated accidentally or incorrectly by other persons.

DIVING OPERATIONS – CHECKLIST VESSEL (EXAMPLE)

(To be completed by the diving supervisor)

Name Vessel:		
Type Vessel:		
Name Captain:		
Name Chief Engineer:		
Date:	**Time:**	**Location:**

CHECKLIST

Step	Action	Confirmed
1	Has the captain (or his official deputy if the captain is not on watch and asleep) approved the diving operations?	
2	Has the Chief Engineer Officer (or his official deputy if the Chief Engineer Officer is not on watch and asleep) approved the diving operations?	
3	Are all bridge personnel aware of the dive operations?	
4	Are all engine room personnel aware of the dive operations?	
5	Has a suitably qualified officer of the watch been appointed to coordinate the isolation of the on-board control equipment?	
6	Will the officer of the watch remain available during the entire period of the dive operations?	
7	If a shift change is expected while the dive operations are in progress, have arrangements been made so that the replacement personnel when they arrive on duty know that the dive operations are in progress and that all necessary risk management measures must remain in place?	
8	Have all necessary measures been taken to safely isolate all equipment dangerous to divers by applying appropriate preventive measures on the bridge, in the engine room or in other relevant places?	
9	Are the proposed isolation control measures sufficient to completely disable / block any possible movement or dangerous situation that may occur in the vicinity of the dive operation?	
10	Are warnings placed in strategic places to warn crew members, other than on the bridge or in the control room, that the relevant equipment has been isolated for safety reasons?	
11	Have "lock-off" isolation procedures been used to minimize the possibility of accidental or erroneous reactivation of the installation / equipment during diving operations within the hazardous areas? OR If it has proven impossible to establish "lock-off" isolation procedures, are members of the dive team present as watchmen for the specific purpose of preventing accidental or erroneous start-up of dangerous machinery by other persons while diving operations are in progress?	
12	Is the vessel showing the correct dive signals? • Alpha flag • Ball- Diamond-Ball • Red-white-red (Light)	
13	Has a VHF radio broadcast been made to warn: Port authorities, Port ship traffic control posts, and all other ships in the area, to inform everyone in the area that dive operations are about to begin?	

14	Are there any other checks or warnings needed? If it does, summarize it here and confirm it:	

	Name	**Signature**
Captain (or his deputy)		
Chief Engineer (or his deputy)		
Diving supervisor		

If any of the above checklist items are NOT CONFIRMED, additional checks and actions will be required before the dive operation can begin.

This checklist is intended to be used in conjunction with the requirements of a work permit / Permit to dive permit that would normally be used for diving from a ship.