

# Subsea Hyperbaric Repairs – Full-Habitat dry welding, Micro-Habitat Dry Welding, and Wet Welding

Presented by the  $\mu$ -Habitat Systems Creator & Chief Architect  
*EUR ING* **EARL L. TOUPS** *MSC CENG CIWE*  
Hyperbaric Welding & NDT Manager

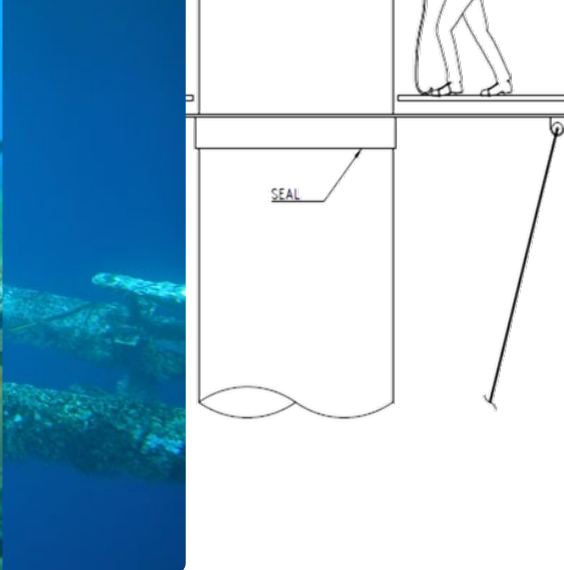
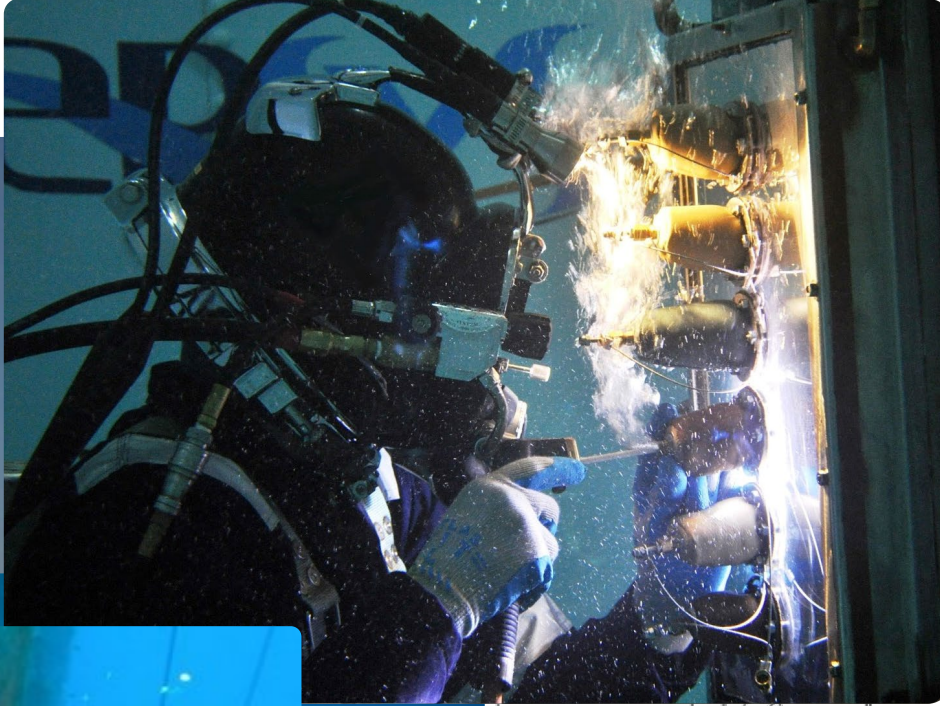
# Introduction



Currently over 60% of global subsea infrastructure is operating beyond its original design life!

Imagine welding a Class 'A' joint at 76 metres deep — through a pair of gloves...

# Challenge



## Limitations of Conventional Systems

**Cofferdams**

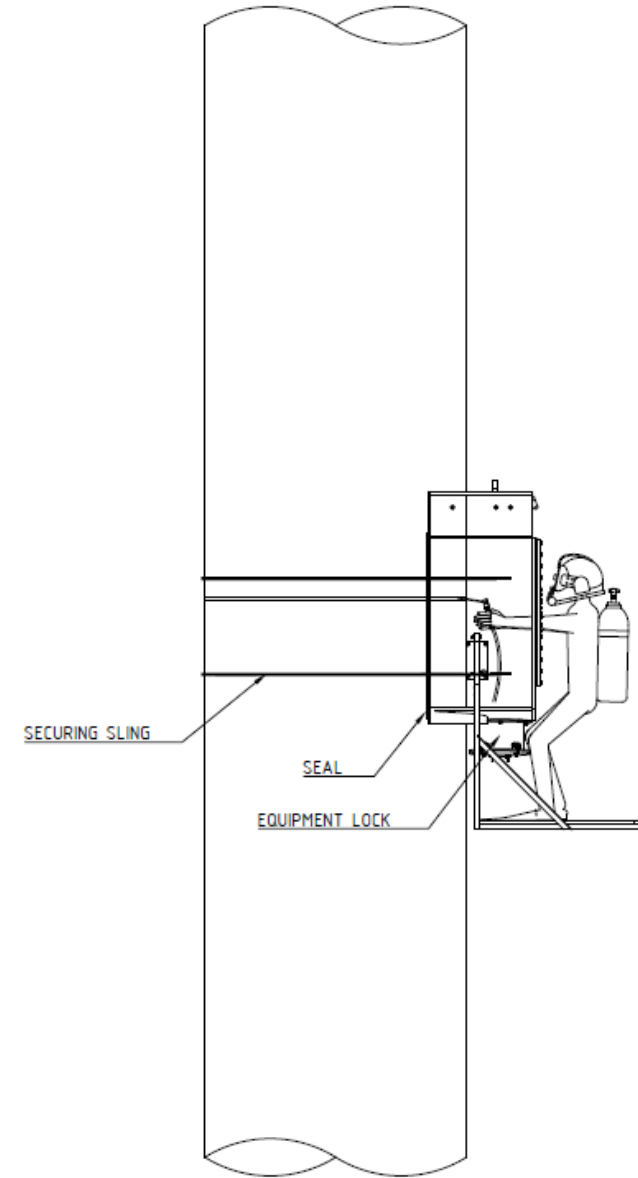
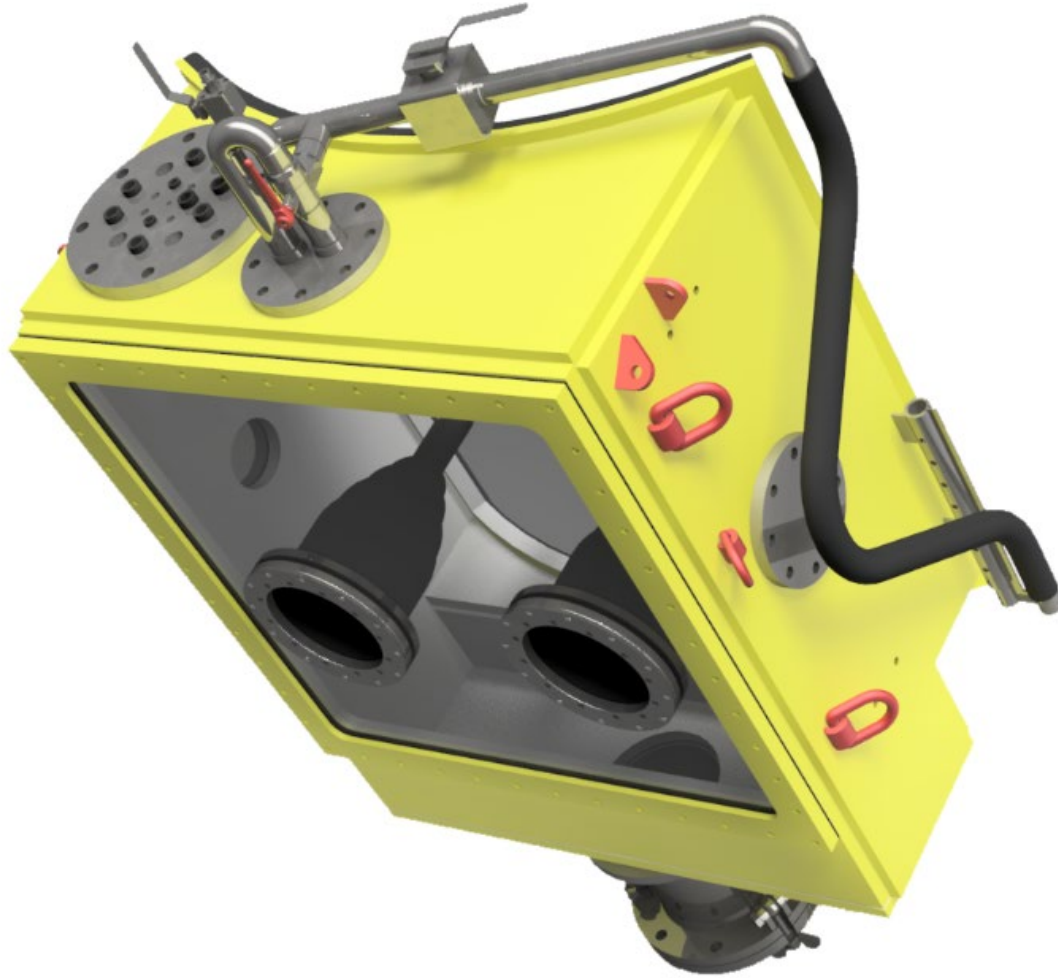
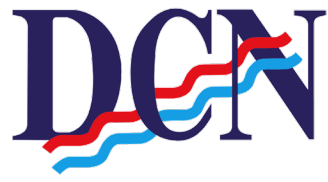
**Conventional Habitats**

**Responsive/Mobile Habitats**

**Dry Spot Welding**

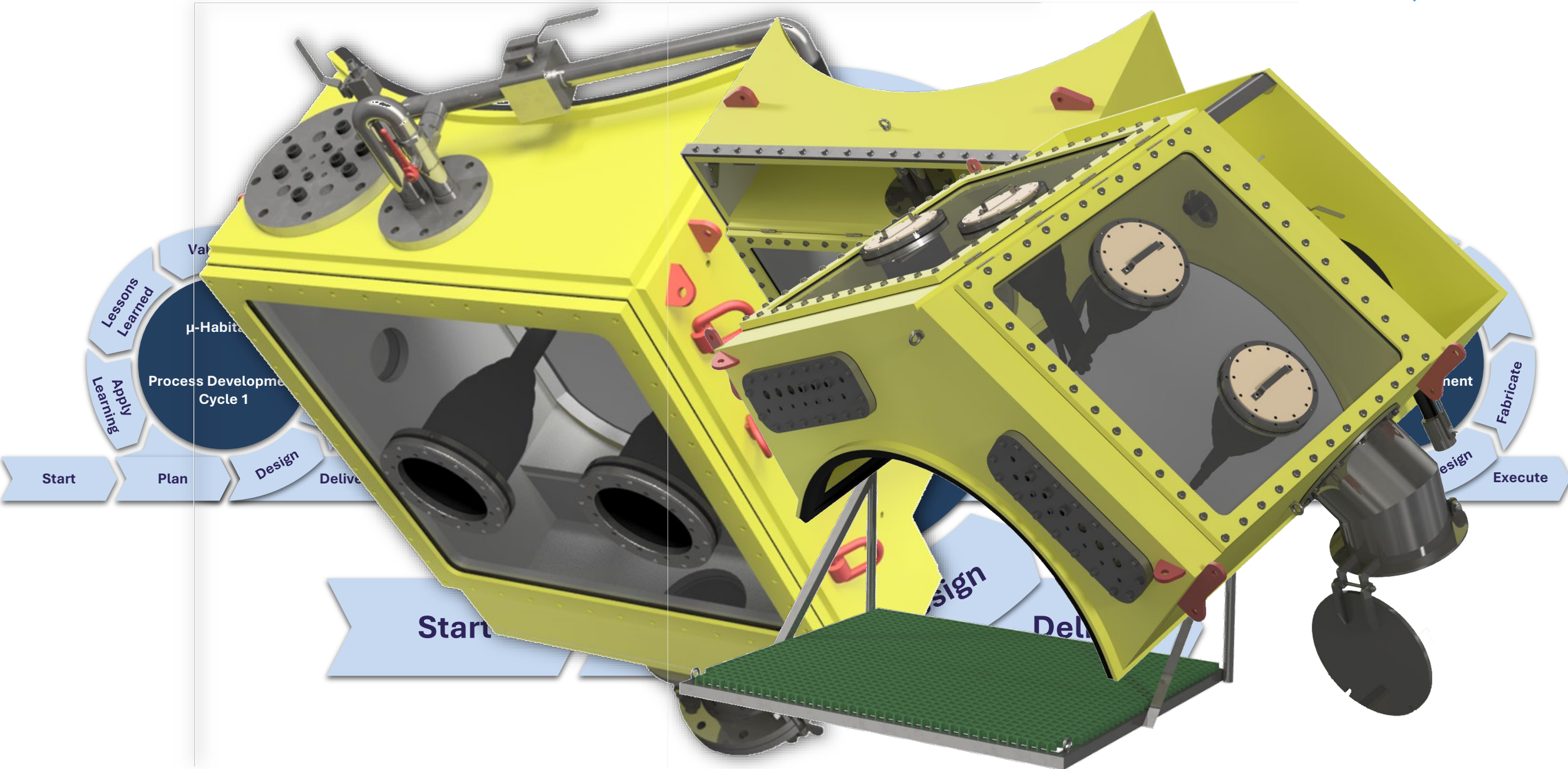
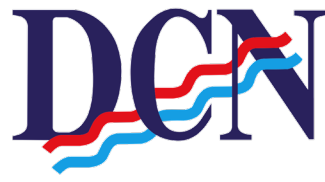
**Wet Welding**

# Micro-Habitat

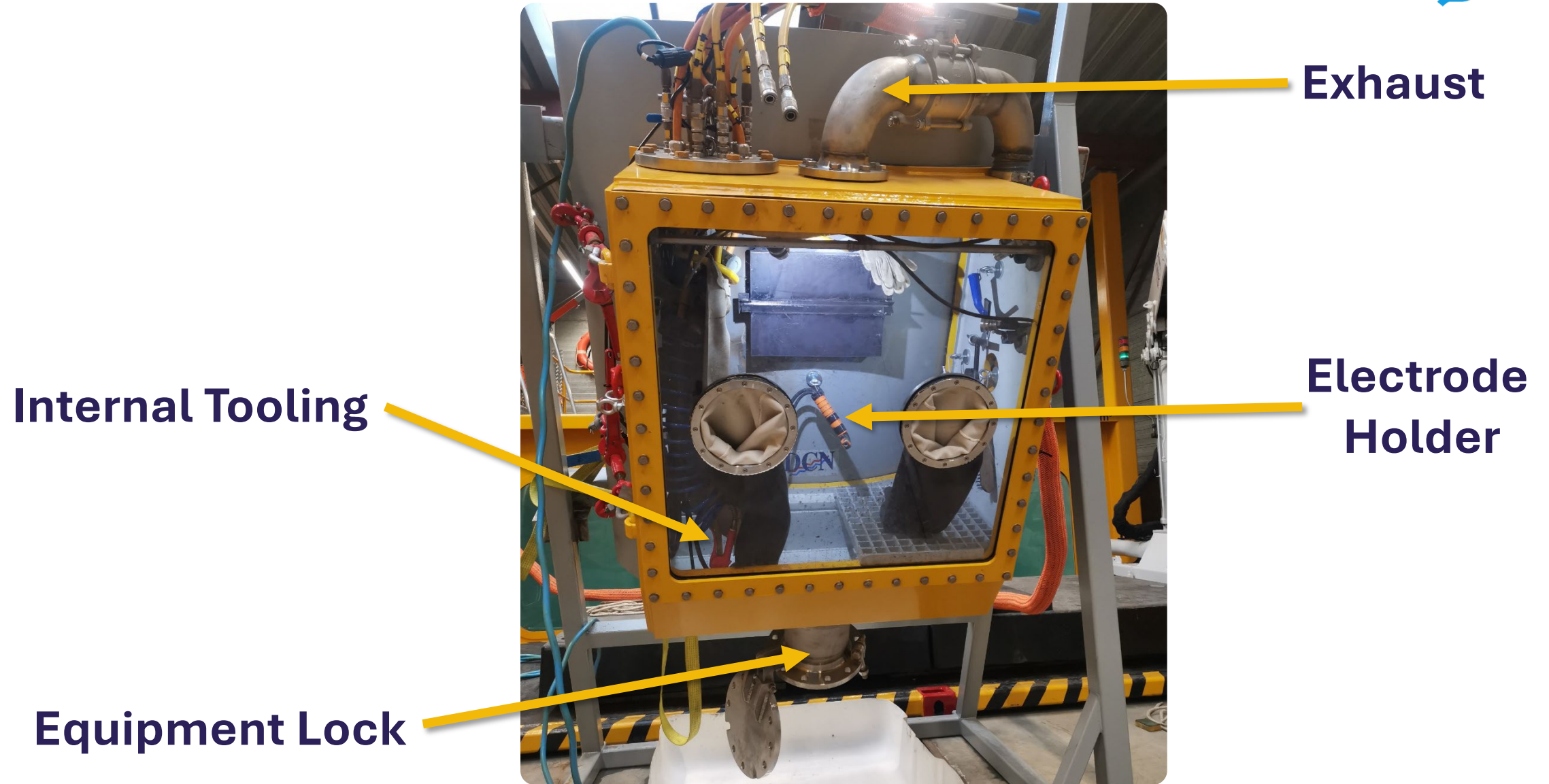




# Micro-Habitat: Design Philosophy



# Micro-Habitat: Key Features



**Exhaust**

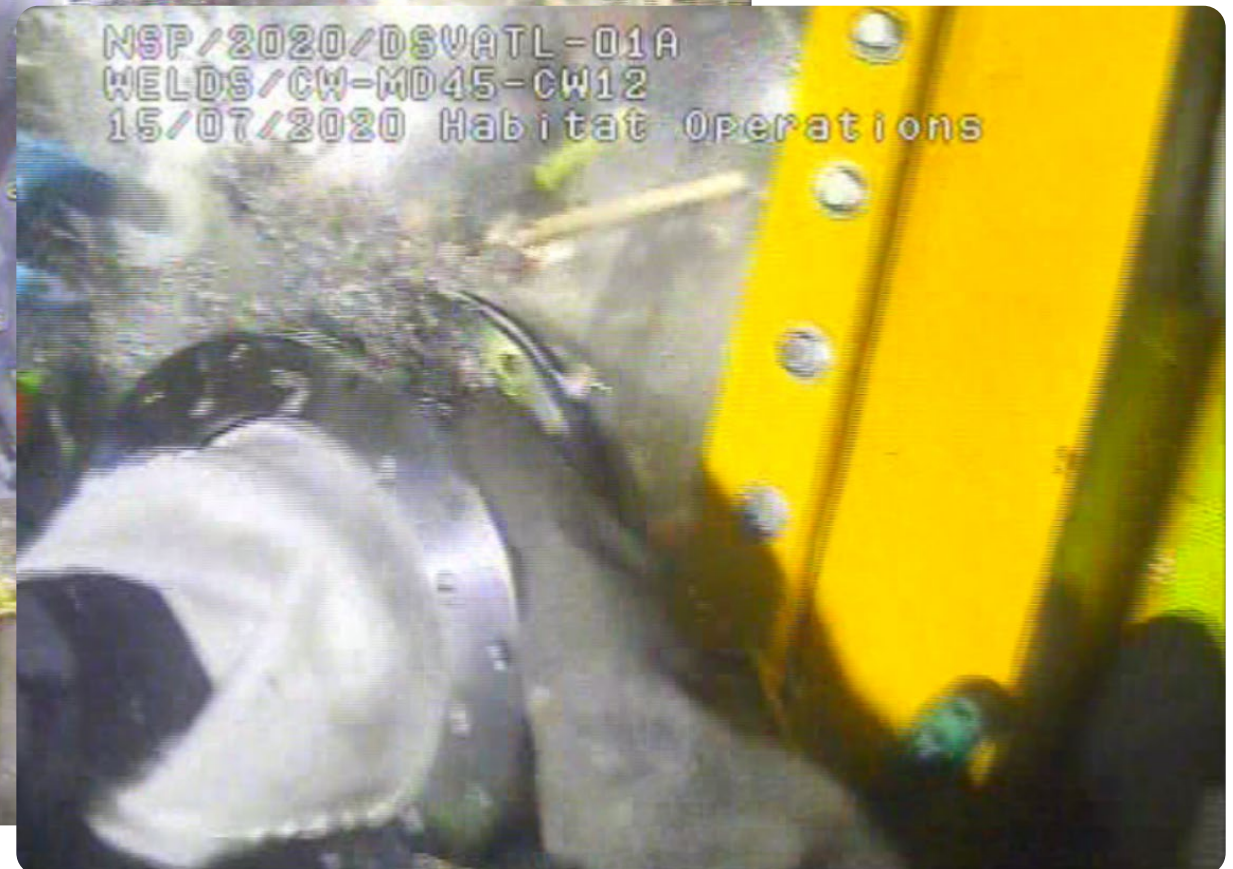
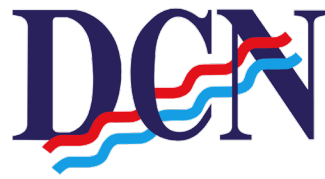
**Electrode  
Holder**

**Internal Tooling**

**Equipment Lock**

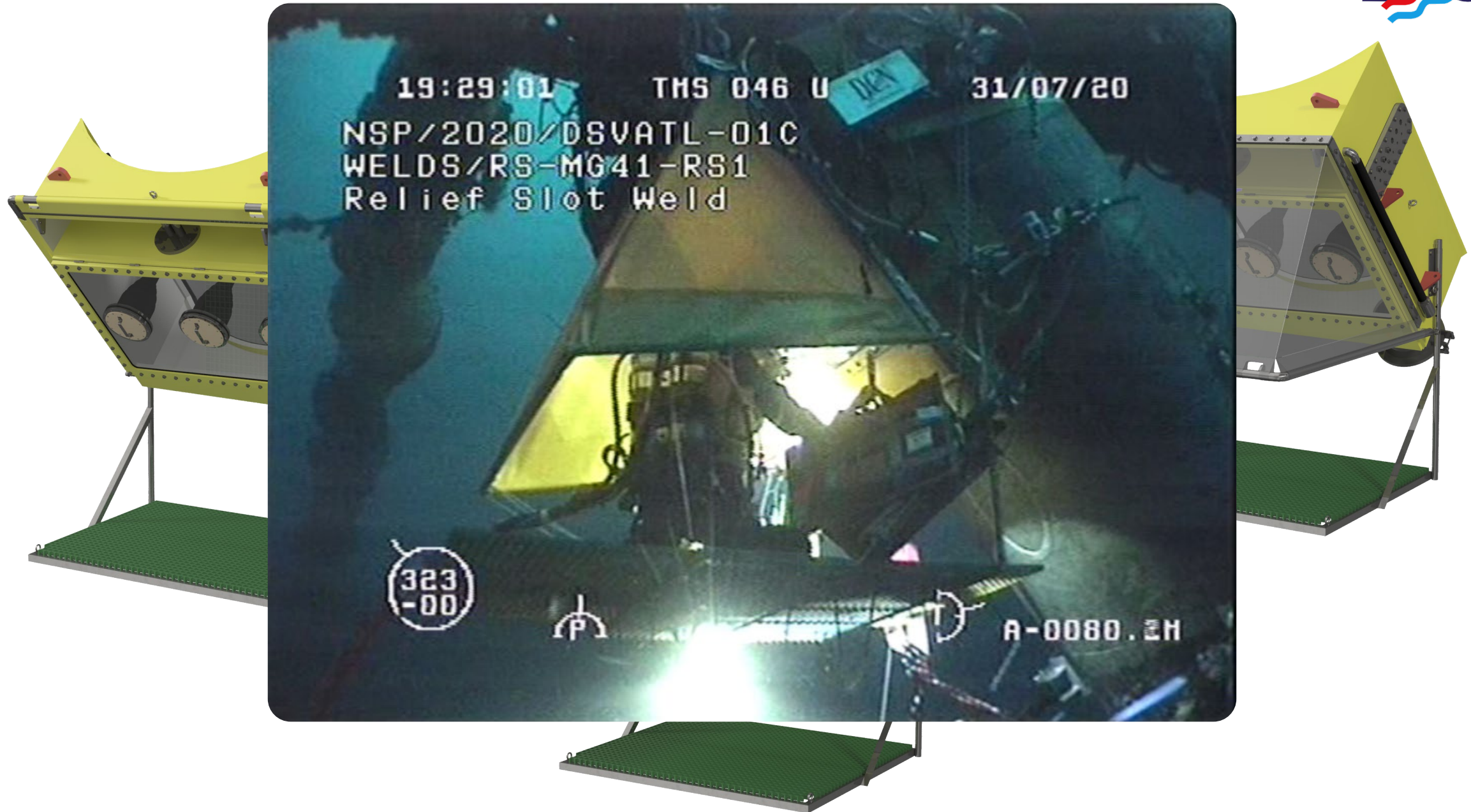
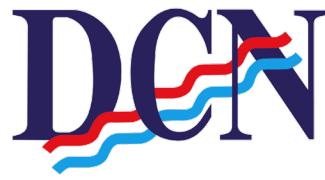


# Micro-Habitat—Glove Changeout



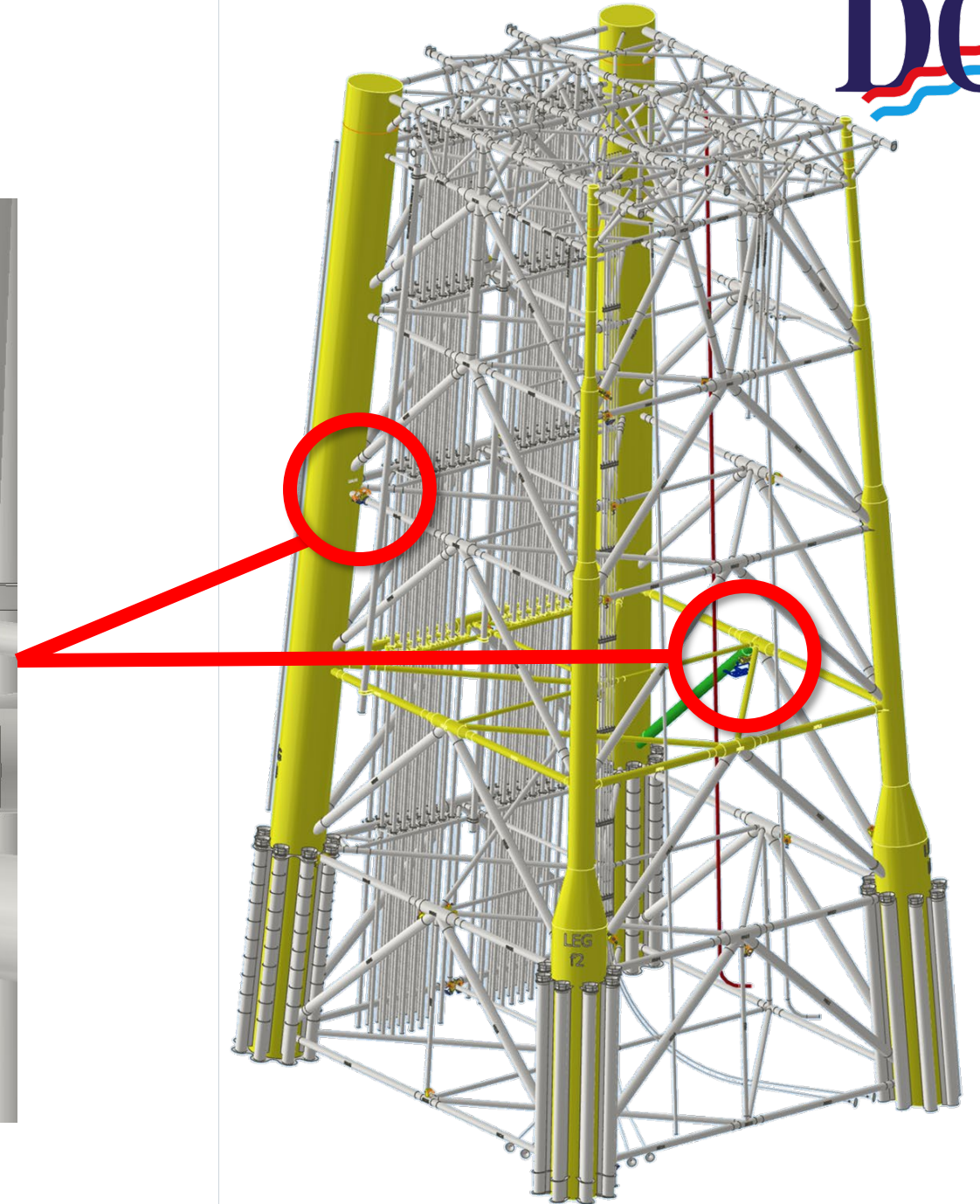


# Micro-Habitat—Window Changeout





# Offshore Execution



# System Comparison



Criteria	Wet Welding	Dry Spot Welding	Hyperbaric Habitat	μ-Habitat
Typical Quality	Class 'A-B'	Class 'A-B'	Class 'A'	<b>Class 'A'</b>
Depth	40m	60m	400m	<b>140m*</b>
Material	<0.37% CE <sub>IW</sub>	<0.45% CE <sub>IW</sub>	<0.50% CE <sub>IW</sub>	<b>&lt;0.50% CE<sub>IW</sub></b>
Restrictions	Negligible	Minimal	Significant	<b>Minor</b>
Safety	Electric Shock Off-Gassing	Electric Shock	Confined Space	<b>Minor</b>
Positional	All - (OH)	All Except OH	All	<b>All</b>
Preheating	No	No	Yes	<b>Yes</b>
Grinding	Yes	No	Yes	<b>Yes</b>
Monitoring	Limited	Limited	Yes	<b>Yes</b>
Ranking	4	3	2	<b>1</b>



# Conventional Habitat Risk Ranking



LIKELIHOOD ●

Certain 5	5	10	15	20	25
Likely 4	4	8	12	16	20
Possible 3	3 ● ● ● ● ●	6	9 ● ● ● ●	12 ● ● ●	15 ●
Unlikely 2	2 ●	4	6	8	10 ●
Rare 1	1	2	3 ● ● ● ●	4 ● ● ●	5 ● ●
	Negligible 1	Minor 2	Significant 3	Serious 4	Major 5

SIGNIFICANCE ○

# Micro-Habitat Risk Ranking



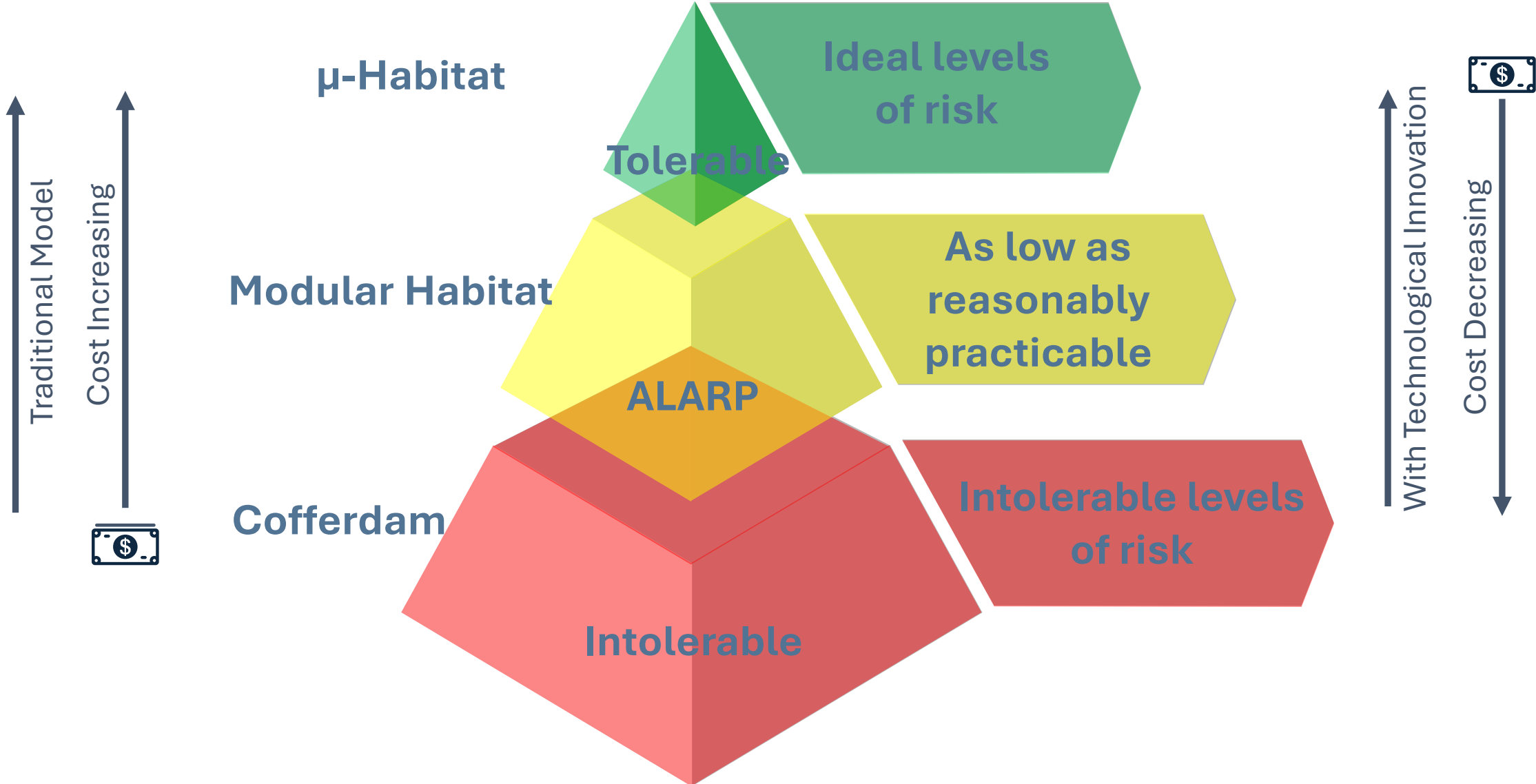
LIKELIHOOD ●

Certain 5	5	10	15	20	25
Likely 4	4	8	12	16	20
Possible 3	3 ●	6 ●	9	12	15
Unlikely 2	2 ● ● ● ● ●	4 ●	6 ● ● ●	8 ●	10
Rare 1	1	2 ● ●	3 ● ● ●	4 ●	5
	Negligible 1	Minor 2	Significant 3	Serious 4	Major 5

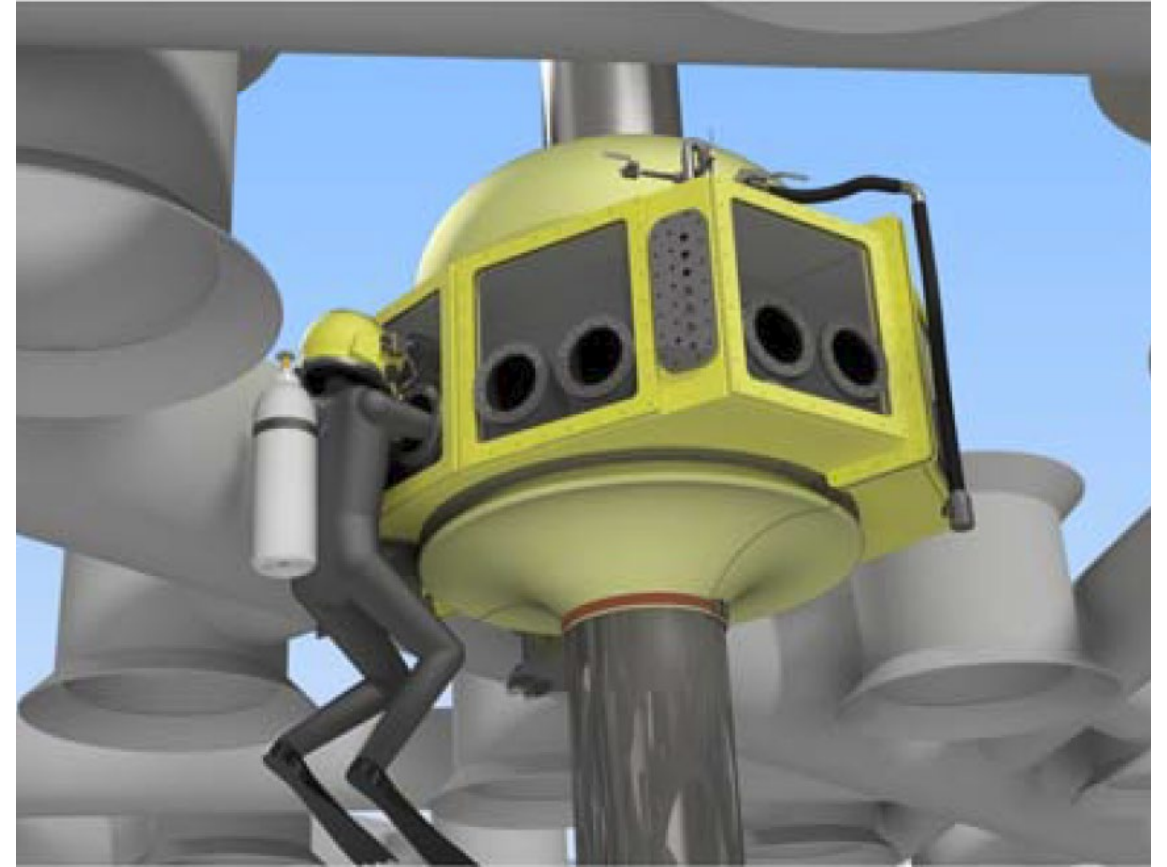
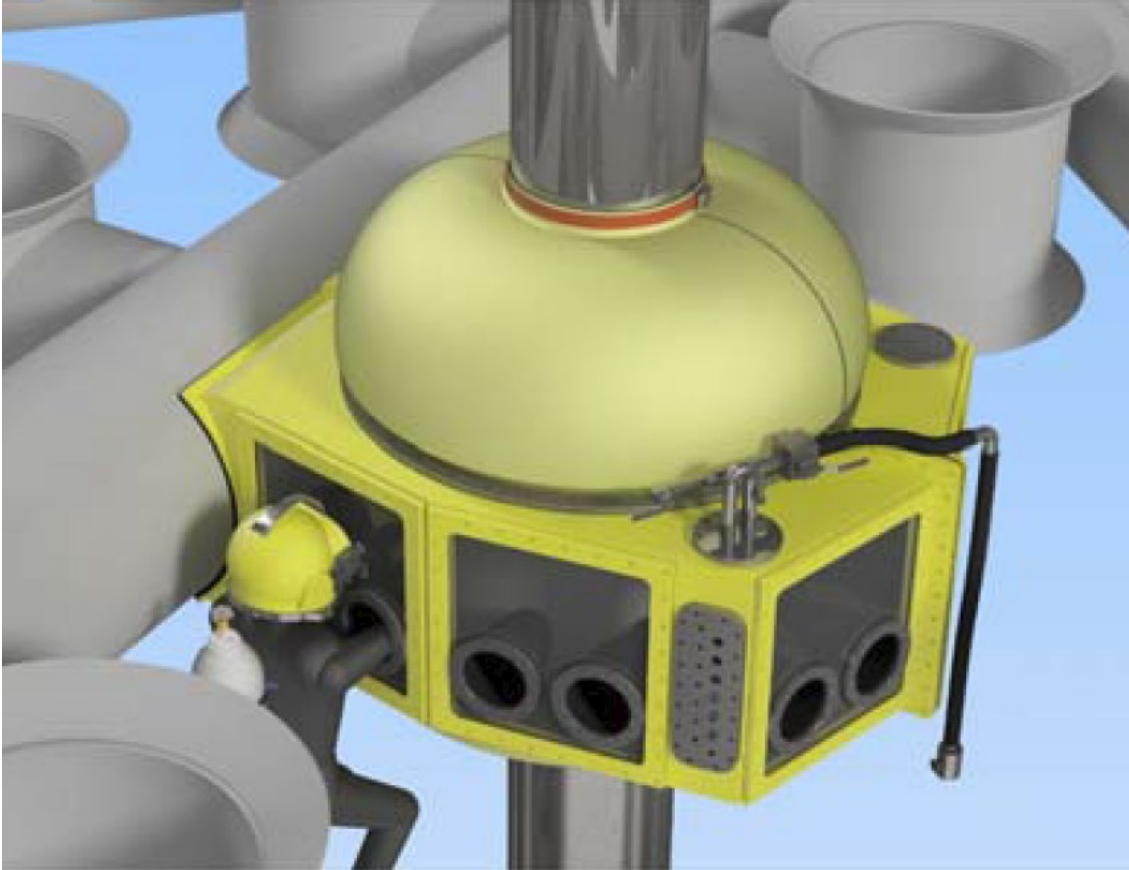
SIGNIFICANCE ○



# Framework Risk Assessment Model



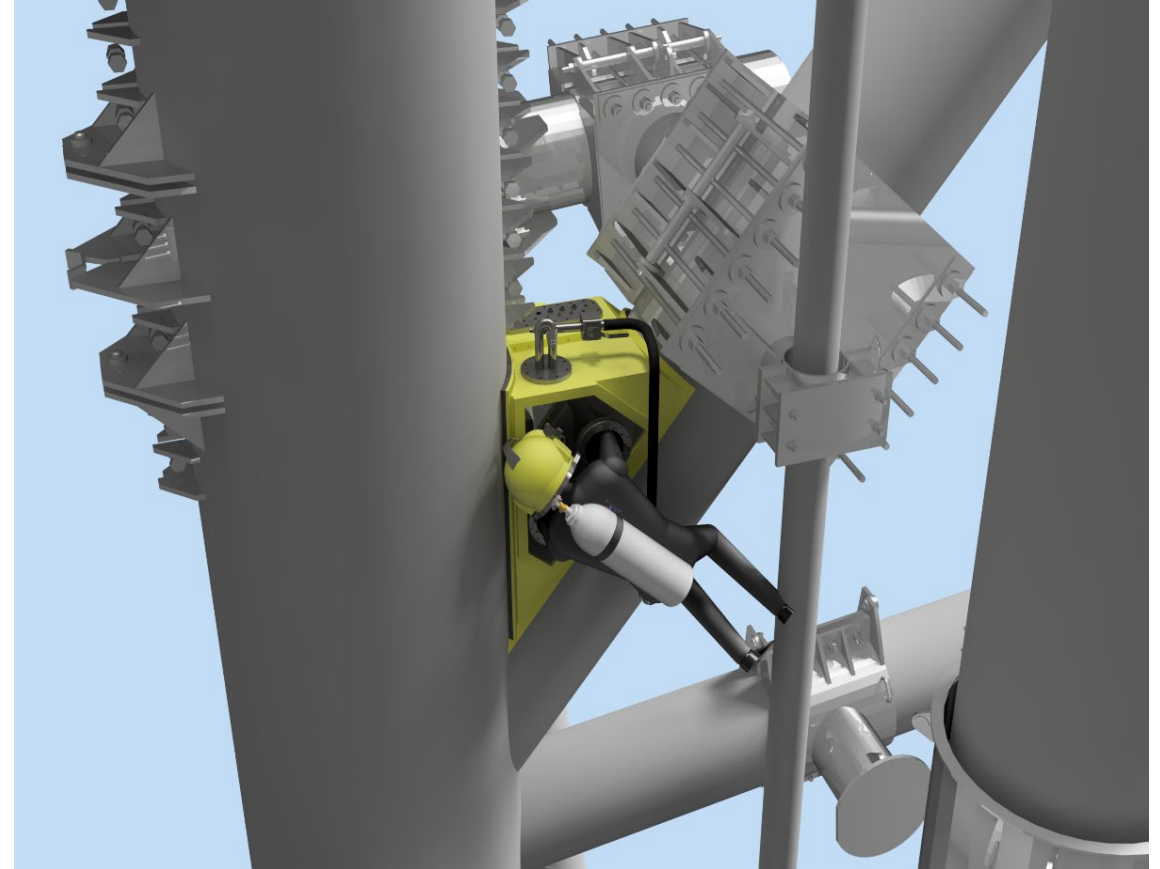
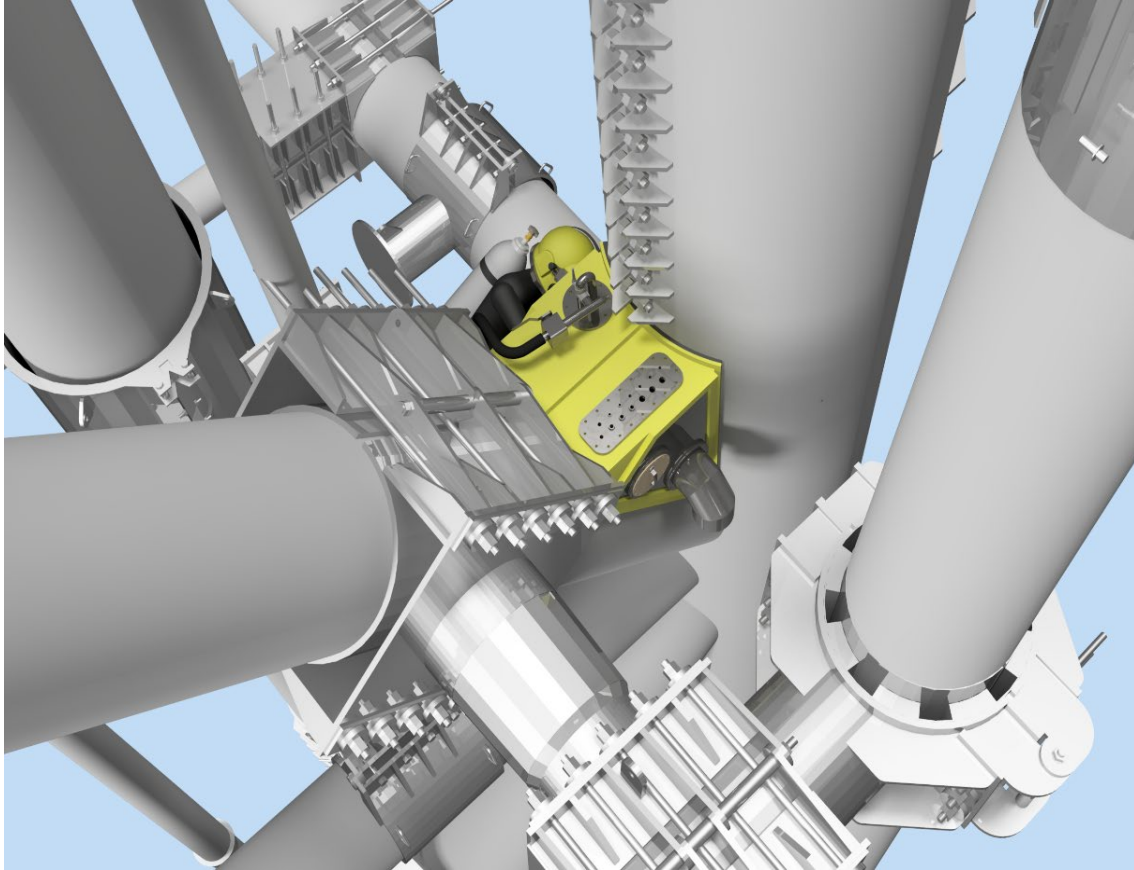
# Current Developments



**Conductor Guides & Risers**



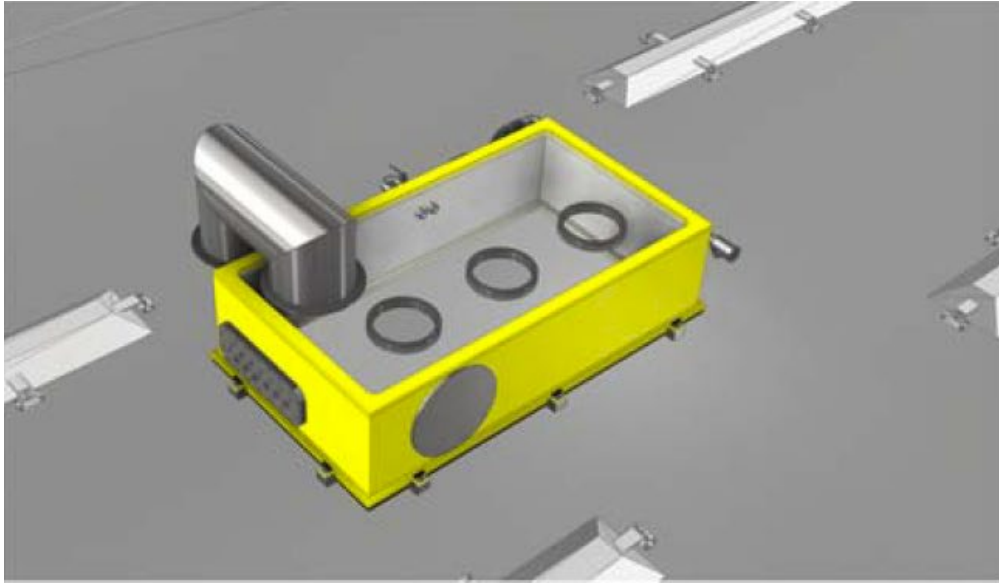
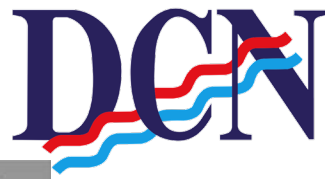
# Current Developments



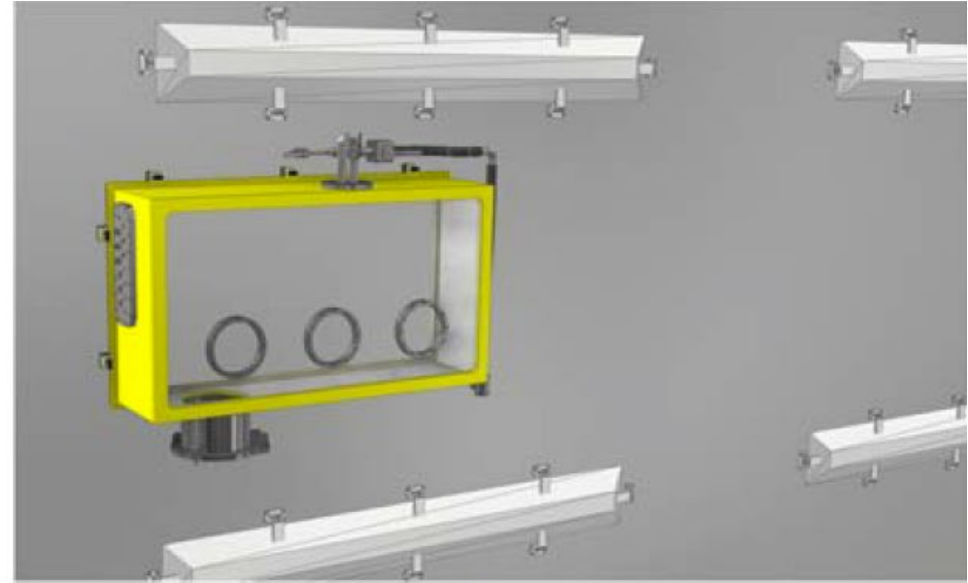
**K-Node Joint**

# Current Developments

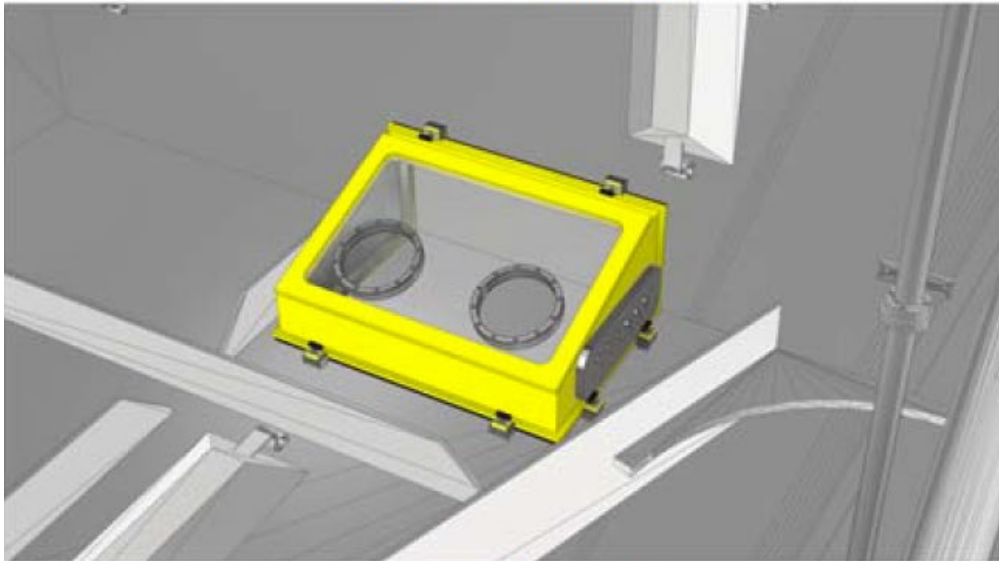
## Subsea Storage Tanks



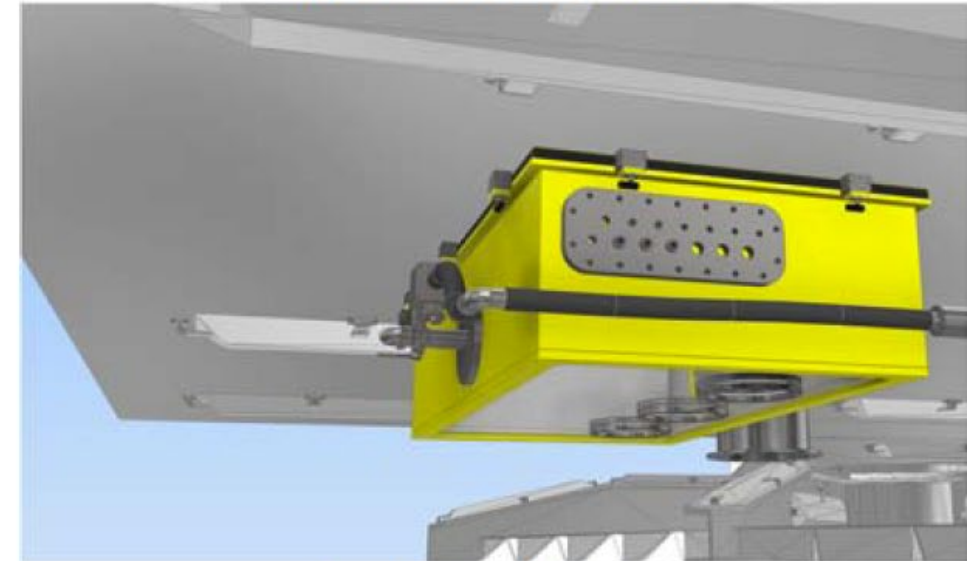
Type 1 – Tank Top



Type 2 - Side Elevations

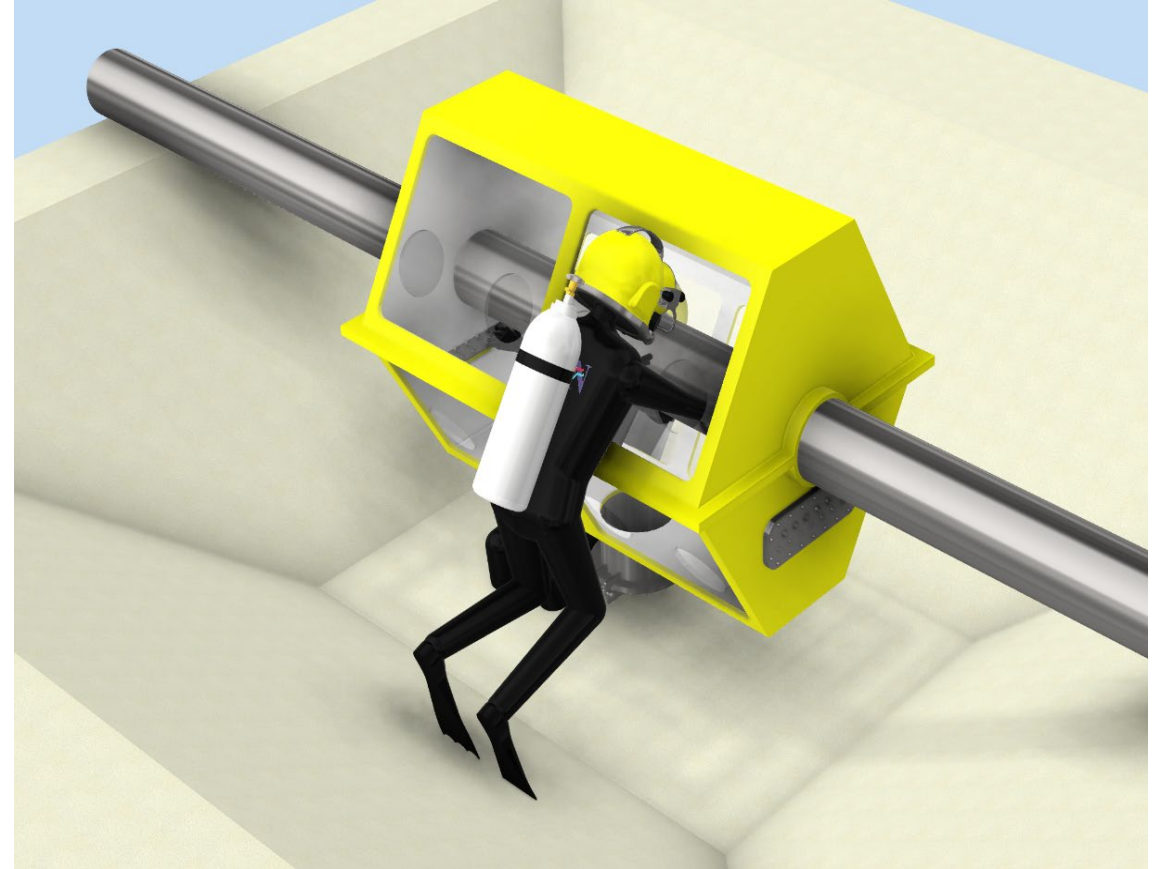
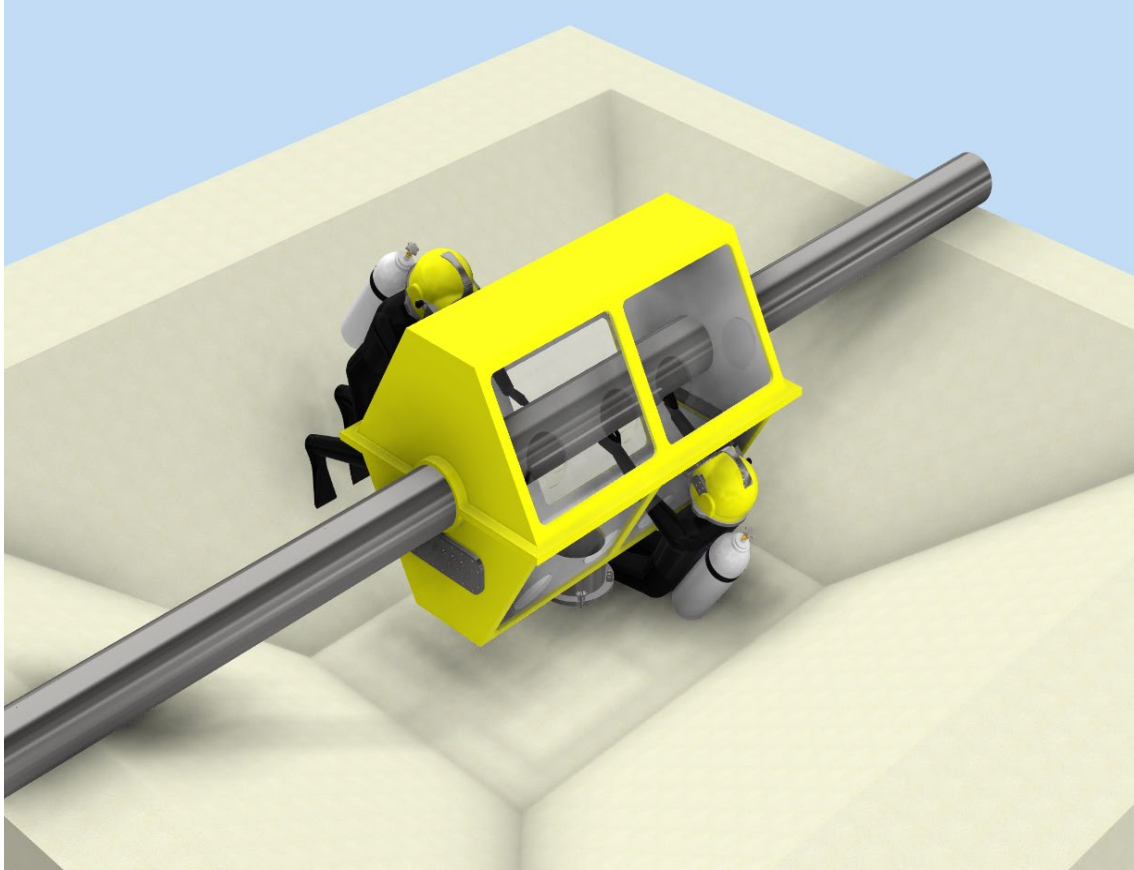


Type 3 - Pile Guides



Type 4 – Tank Bottom

# Current Developments



**Pipeline Repairs**



# Questions & Answers



Thank you very much for your attendance and attention. I hope you enjoyed the presentation and if you have any questions or would like to talk to me afterwards, I would love to engage with you.