

# LEAN DUPLEX STAINLESS STEELS FOR SOUR SERVICE

By

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# COMPOSITION

ALLOY	NOMINAL COMPOSITION (wt%)							PREN*
	Fe	Cr	Ni	Mo	N	Cu	W	
22%Cr Duplex	Bal	22	5	3	0.16	-	-	34
AL2003™ (UNS S32003)	Bal	21	3.5	1.8	0.17	-	-	>30
ZERON 21CLD	Bal	21	4	1.8	0.17	0.3	0.3	>30

- ALL OF THESE ALLOYS ARE APPROXIMATELY 50/50 AUSTENITE FERRITE.
- THE LEAN DUPLEX ALLOYS HAVE REDUCED NICKEL AND MOLYBDENUM TO REDUCE COSTS.
- BOTH LEAN DUPLEX ALLOYS HAVE A PREN>30.

# MECHANICAL PROPERTIES

FORM	ALLOY	0.2% PROOF STRESS (MPa)	TENSILE STRENGTH (MPa)	ELONGATION (%)
WROUGHT	22%Cr Duplex	450	620	25
	AL2003	450	620	25
CAST	22%Cr Duplex	415	620	25
	ZERON 21 CLD	420	650	25

- THE LEAN DUPLEX ALLOYS OFFER EQUIVALENT OR SUPERIOR STRENGTH TO THE 22%Cr ALLOY AT ROOM TEMPERATURE.
- AT ELEVATED TEMPERATURES THE MECHANICAL PROPERTIES ARE ALSO SIMILAR.

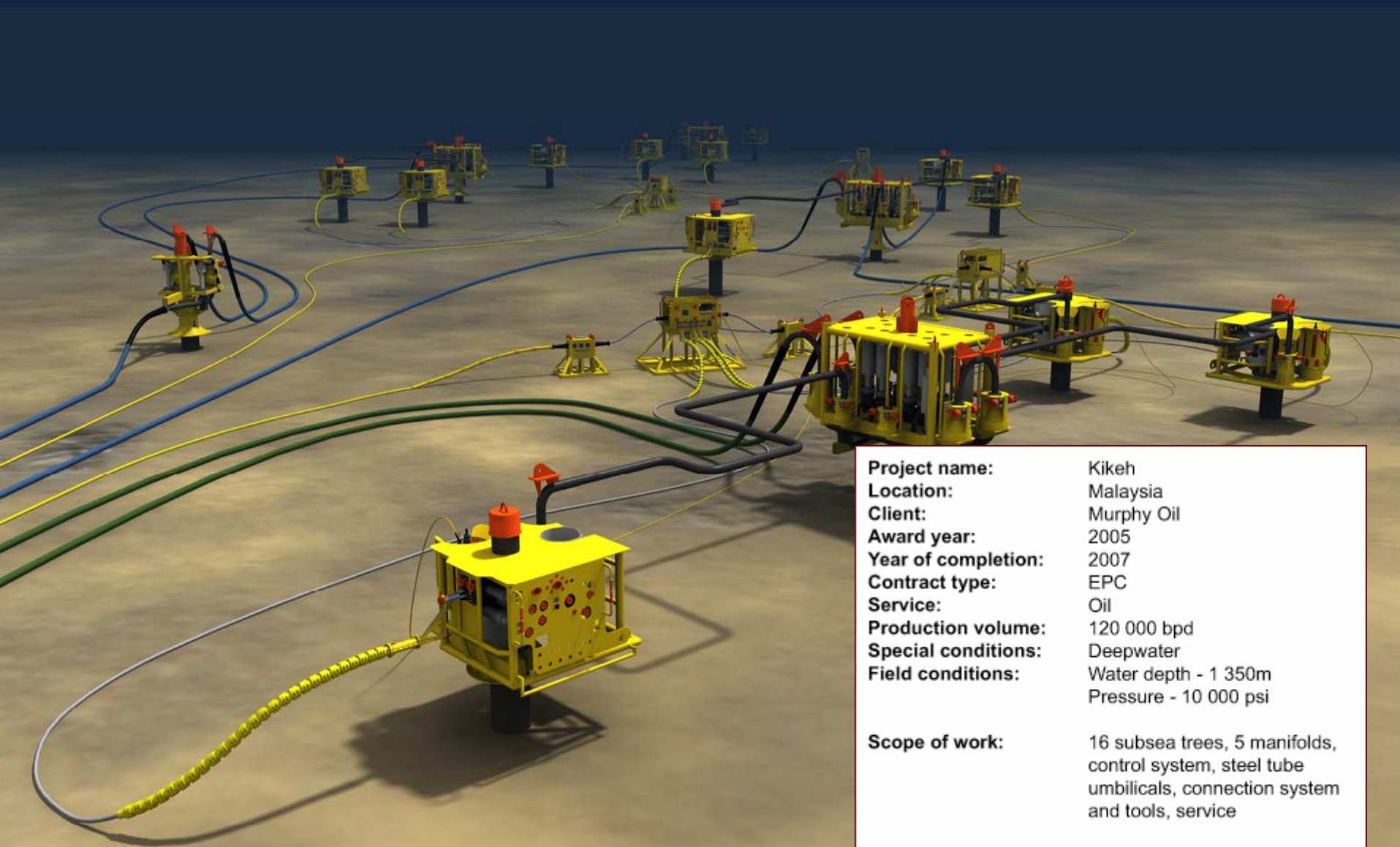
# CORROSION RESISTANCE

- **ISO 15156 PART 3 STATES THAT DUPLEX STAINLESS STEELS WITH A 30<math>>PREN</math><math><40</math> ARE SATISFACTORY UP TO 0.1 bar H<sub>2</sub>S.**
- **A SULPHIDE SCC TEST IN ACCORDANCE WITH EFC 17 WAS CARRIED OUT ON WROUGHT, CAST AND WELDED MATERIAL UNDER THE FOLLOWING CONDITIONS:**
  - **20% Sodium Chloride**
  - **0.1 bar H<sub>2</sub>S**
  - **1.2bar CO<sub>2</sub>**
  - **pH=3.5**

**ALL OF THE MATERIALS RESISTED CRACKING WHEN STRESSED TO 100% OF THE ACTUAL 0.2% PROOF STRESS.**



# Kikeh Subsea Field Lay Out



<b>Project name:</b>	Kikeh
<b>Location:</b>	Malaysia
<b>Client:</b>	Murphy Oil
<b>Award year:</b>	2005
<b>Year of completion:</b>	2007
<b>Contract type:</b>	EPC
<b>Service:</b>	Oil
<b>Production volume:</b>	120 000 bpd
<b>Special conditions:</b>	Deepwater
<b>Field conditions:</b>	Water depth - 1 350m Pressure - 10 000 psi
<b>Scope of work:</b>	16 subsea trees, 5 manifolds, control system, steel tube umbilicals, connection system and tools, service
<b>Manufacturing:</b>	Malaysia, UK, Norway, USA
<b>Service base:</b>	Kuala Lumpur, Malaysia

## EXPERIENCE IN OIL & GAS

- ➔ **MORE THAN 15km OF PIPE WITH UNS S32003 CARCASS HAS ALREADY BEEN INSTALLED IN A MAJOR SUBSEA OIL FIELD (ref EUROCORR 07 Paper given by R. Clements from Wellstream).**
- ➔ **COST SAVINGS WERE ACHIEVED FOR THE PROJECT DUE TO THE MUCH LOWER ALLOY CONTENT COMPARED WITH 22Cr (which would have otherwise been necessary at the 1400m water depth).**

# CONCLUSIONS

- **THESE LEAN DUPLEX STAINLESS STEELS OFFER THE STRENGTH OF 22%Cr DUPLEX STAINLESS STEEL.**
- **THESE LEAN DUPLEX STAINLESS STEELS OFFER THE SSCC RESISTANCE REQUIRED OF 22%Cr DUPLEX STAINLESS STEEL.**
- **LEAN DUPLEX IS AVAILABLE IN BOTH WROUGHT AND CAST FORMS.**
- **THE COST OF THESE LEAN DUPLEX IS ABOUT THE SAME AS 316L STAINLESS STEEL BUT THE STRENGTH ADVANTAGES OF LDSS MAY ALLOW FOR WEIGHT REDUCTIONS.**