NEW APPROACHES AND TECHNOLOGIES TO MANAGE EXTERNAL CORROSION AND CUI

ICORR ABERDEEN BRANCH & NACE JOINT MEETING

27th May 2014

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SHELL OPERATING IN THE NORTH SEA

- 8 Fixed Offshore Installations
  - Shearwater
  - Gannet
  - Nelson
  - Brent C
  - Brent A, B, Near EOFL
  - Brent D (decommissioned)
- 2 FPSOs
  - Anasuria
  - Curlew
- 2 Onshore Installations
  - Saint Fergus and
  - FLNG (Mosmorran, Braefoot Bay)

TODAY'S OBJECTIVE

To share some of Shell experiences, managing key integrity threats associated to atmospheric corrosion and corrosion under insulation.

Focus topics:

- How to approach it
- New technologies

1

HOW TO APPROACH IT

GENERAL PRINCIPLES – WHERE TO START?

What:

Good understanding of the condition of the Fabric in the installation and the risks associated with it.

- Reliable and complete (coating) Inspection data that can be easily calibrated with time.
- Scope definition and prioritization.
- Sensitivity analysis and validation of priorities – how robust they are
- On site verification of prioritised scope - How it compares vs engineering judgment.

When:

- What is the acceptable execution window

GENERAL PRINCIPLES – WHERE TO START?

How:

- Scope optimisation: alignment to execution practicalities
- Define the required execution pace and size
  - Routine, mini campaign, mid size or major campaign

By Whom:

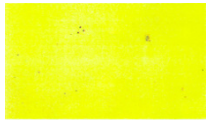
- Contract strategy
- Competences of contractor personnel, QA/QC roles, safety records
- Project management skills of painting contractor!

Where:

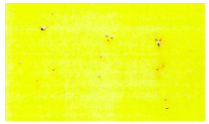
- Scope prioritisation and access constrains

CONSTRAINED ENVIRONMENT

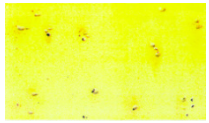
COATING MANAGEMENT INTERVENTION LEVELS



Re 1 (0,05%)

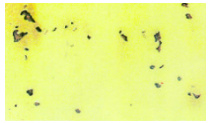


Re 2 (0,5%)

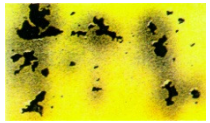


Re 3 (1%)

Spot



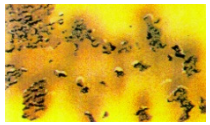
Re 4 (3%)



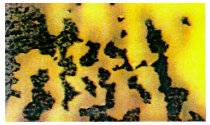
Re 5 (8%)

Refurbishment

Renovate



Re 6 (15-20%)



Re 7 (40-50%)

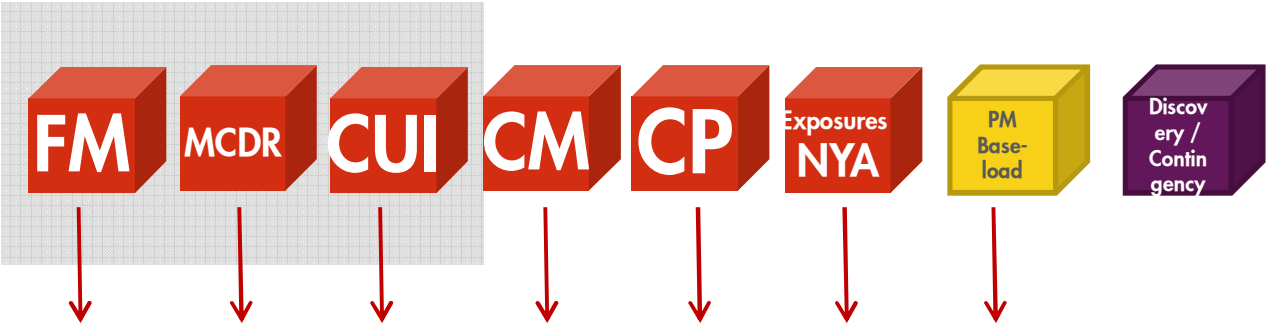
Re 8 (75-85%)

Re 9 (95%)

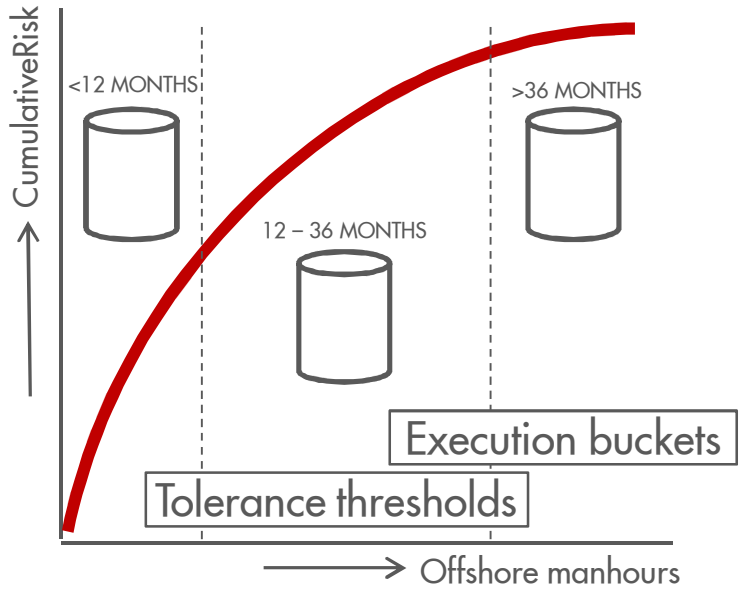
VISIBLE CORROSION DEGREES (DEP 70.48.11.30-Gen)

The pictures on the left are used for the visual determination of the percentage of surface rusting. These pictures are based on standards such as the European Scale of Degree of Rusting and ASTM D 610.

RISK MANAGED APPROACH

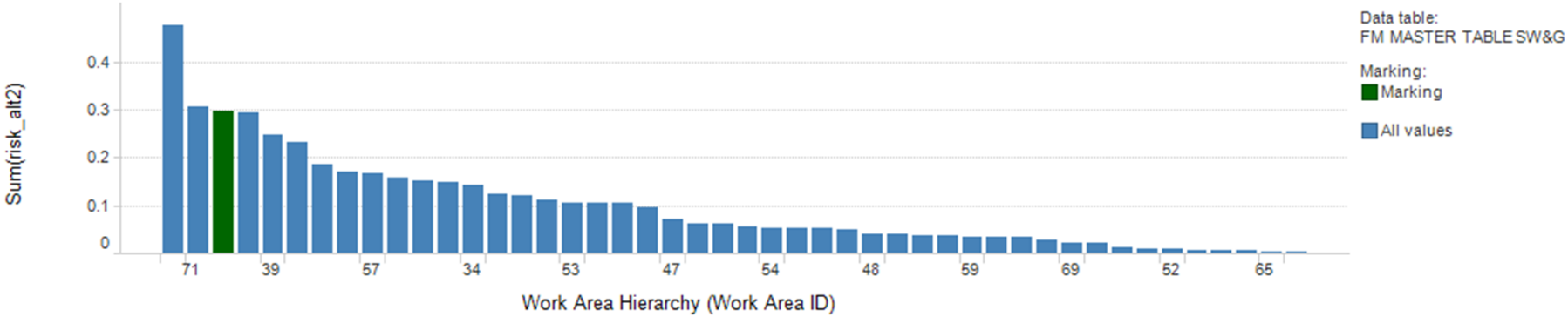


SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No impact					
1	Slight injury or health effect	Slight damage	Slight effect	Slight impact					
2	Minor injury or health effect	Minor damage	Minor effect	Minor impact					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate impact					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major impact					
5	More than 3 fatalities	Massive damage	Massive effect	Massive impact					

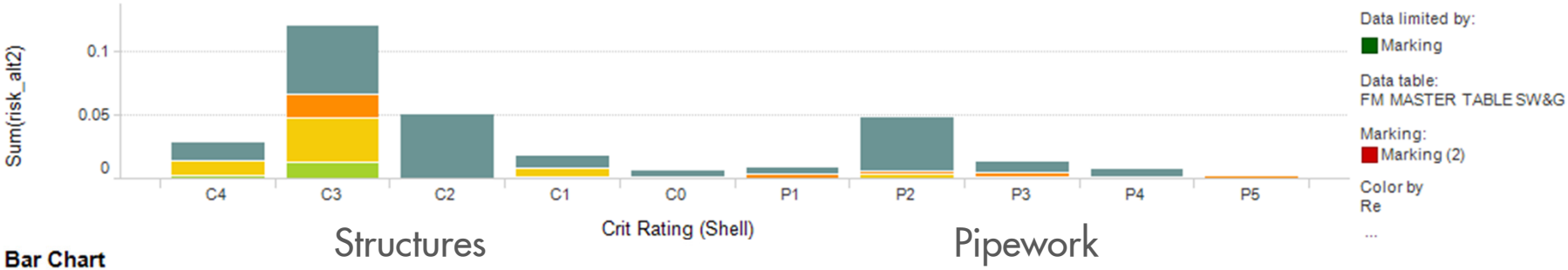


FM: A HIGH RISK WORK AREA: MODULE C4

Bar Chart



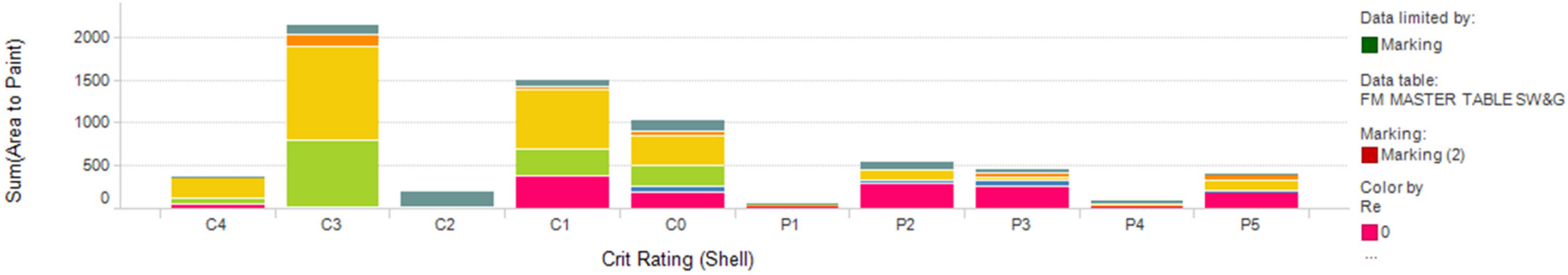
Bar Chart



Structures

Pipework

Bar Chart



Filter Settings
FM MASTER TABLE SW&GAA
- Facility: (Gannet)
- Re_intervention: 0 1 2 3 5 7

MCDR MASTER TABLE SW&GAA
- Open: (Open)

SENSITIVITY ANALYSIS

- Sensitivity analysis carried out between pipework and structures. Purpose is to test if scope selection proposed is robust to changes and pipework/structures biases.

Colour indicates ranking (RED = high risk/high priority - WHITE = low risk/low priority)
Different lines indicate different ranking methods

	Work Area																																				
Ranking	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	61	62	65	67	68	69	70	71	72	73
TA Review (=MSW Rev A Scope Selection)	1	2	13	17	21	3	9	12	24	40	4	11	10	31	30	5	18	26	19	28	39	27	23	14	42	34	32	25	43	41	35	36	20	6	16	22
Pipework:Structures 1:1	13	6	7	28	43	5	3	4	12	35	8	2	19	21	29	14	24	32	41	17	25	10	11	9	39	33	34	30	45	31	38	37	27	1	18	46
Pipework:Structures 10:1	6	3	15	22	39	2	4	1	12	32	7	5	8	19	24	10	23	25	41	21	30	17	14	16	40	34	35	27	45	33	38	37	31	9	20	46
Pipework:Structures 100:1	5	3	23	15	28	2	4	1	12	25	7	8	6	13	19	9	21	18	40	30	33	29	14	24	42	37	35	20	45	36	41	39	34	17	22	46
Pipework only	5	3	26	15	22	2	4	1	12	21	7	8	6	13	18	9	20	16	31	32	36	35	14	28	42	39	33	19	45	38	41	40	37	34	23	46
Pipework:Structures 1:10	18	7	4	28	44	10	3	9	11	35	12	2	23	20	30	16	24	34	41	14	25	6	8	5	39	32	33	31	45	29	38	37	26	1	17	46
Pipework:Structures 1:100	18	7	4	28	44	10	3	11	9	35	12	2	25	20	30	17	23	34	41	14	24	6	8	5	39	32	33	31	45	29	38	37	26	1	15	46
Stuctures only	18	7	4	28	44	10	3	11	9	35	12	2	25	20	30	17	23	34	41	14	24	6	8	5	39	32	33	31	45	29	38	37	26	1	15	46

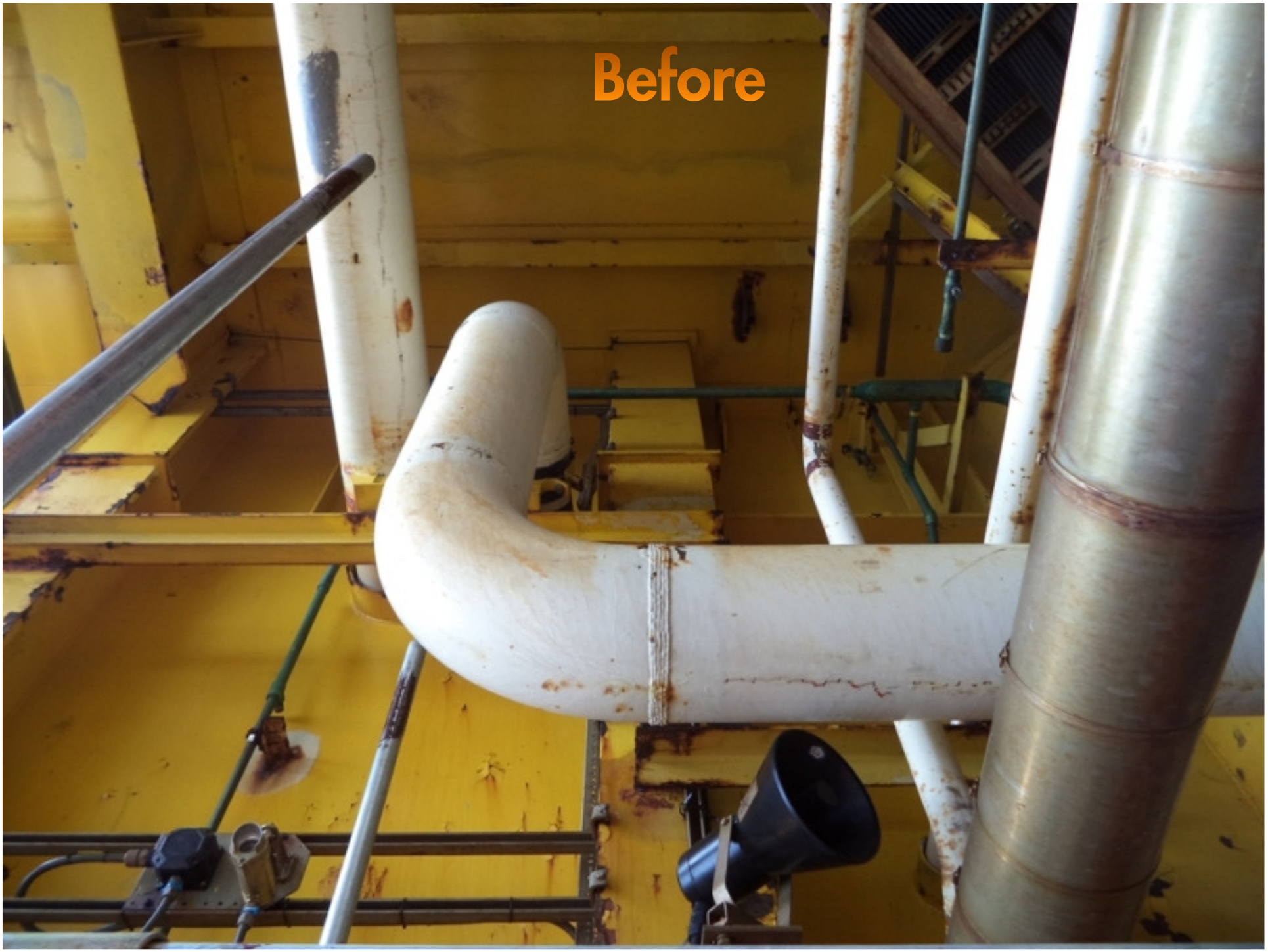
EXECUTION STRATEGIES

- Coating is generally in **Good** condition (i.e. average coating condition Re/Ri 2). Fabric to be managed through the MCDR/Anomaly approach. Review approach in 3 years time.
- Coating is in fair-to good condition. Risk to be managed with a small team as part of the core crew, Modular approach with areas defined by MCDRs/Anomalies. Review approach in 3 years time
- Coating in fair condition. Campaign type approach required, duration required by scope size to mitigate unacceptable risks (walk to work)
- Coating overall in poor condition/strong business driver to extend the life. Major campaign type approach to mitigate unacceptable risks (flotel)
- Fit for purpose strategy (safety critical elements) for installations to be decommissioned in the very short term.

Site Set Up

Site Set Up - Compressors

Site Set Up - Scaffolds


Before


After

Before

After

Before


After

2

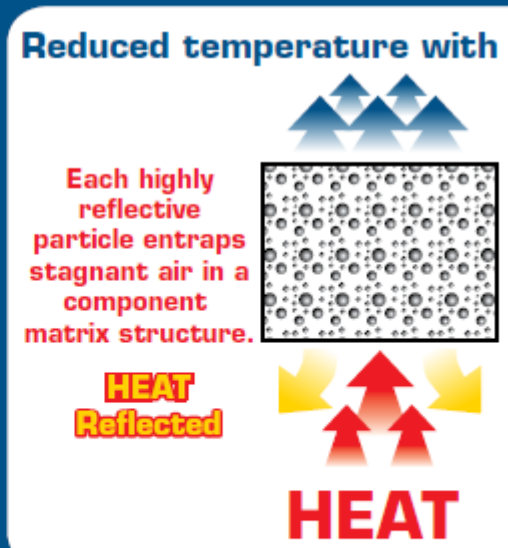
NEW TECHNOLOGIES

THERMAL INSULATING PAINT – HOW DOES IT WORK?

Mascoat®

INDUSTRIAL–DTI

How does the coating work? Mascoat Industrial-DTI applies the common physics principles of reflectivity, conduction, emissivity and absorpstance. Its microscopic particle structure reflects a high percentage of the radiant heat gain back to the environment from which it originated. Each ceramic particle encapsulates air, thereby offering a slow path of thermal transfer. This high content of entrapped and stagnant air blocks thermal transfer very efficiently. In addition, the coating's low emissivity allows for low heat flux. The combination of these factors allows for total thermal dissipation across the surface of the coating. The unique composition of the coating makes it extremely efficient for its thickness and prevents substrates from gaining heat, making those surfaces cooler to the touch.



THERMAL INSULATING PAINT

Removes the threat of CUI

Field of Application

- Personnel protection and heat conservation for process stability.
- Not suitable on heat traced or winterised lines.

Components:

- CRA pipework and carbon steel pipework where the threat of internal corrosion is negligible (i.e. dry gas lies in gas export system, gas lift) preferably 4" and above (a lot of product wasted when it is used on small bore piping).
- Vessels: carbon steel vessels with internal CRA cladding and solid CRA vessels.

THERMAL INSULATING PAINT

Temperature envelope

- Max temperature limit set up as 120 deg C. This is related with a thickness of Max 3 mm due to inspection limitations for thicker coating.
- Coating surface temperature can be higher than 65 deg C. However due to the emissivity properties, a person can put the hand for 5 seconds without any burns.

NELSON V-1010

NELSON V-1010

NELSON V-1010

THERMAL INSULATING PAINT

RIG VIEW

Shell's answer to Google's StreetView

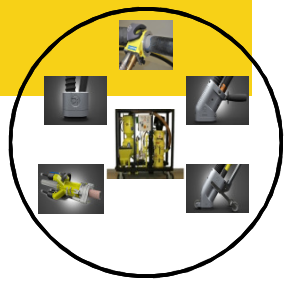
Developed with UTEC Starnet Geomatics, users can 'stand' in the facilities and look around in a 'bubble view', and 'jump' to other locations.

Once satisfied they are in the correct location, users can open the 'Leica TruView' Internet Explorer Plugin and measure onscreen distances, accurate to ~10mm. For those who want <1mm accuracy, a more powerful version is available

RIG VIEW

- Inspection
- Eng. Mods
- Turn around
- Onshore ops support
- Painting

VACUUM BLASTING



Closed Circuit Surface Preparation Tools
From Concept to Reality




2011 – In-Use Product
St Fergus/Mossmorran



2010 – Prototype 3 – Mossmorran

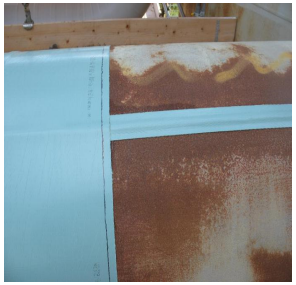

2007 – Prototype 2 – Fawley

2005 – Design Brief – Shell/ExxonMobil /Fawley

WOOD GROUP PSN

Mossmorran FNGL Fife Scotland

As a part of the rejuvenation project at a Shell site in the UK, the main intention was to extend the life of asset and make a saving in application while at the same time offering a solution that would contribute to the stringent environmental and safety demands, bringing satisfaction to the client, contractor and the local regulation authorities



Minimum acceptable surface preparation as per ISO St2 / St3

Heat Traced Stopaq & Insulation

Stopaq Basecoat applied to Structural steel

Stopaq CZ

Stopaq CZ

Stopaq outer wrapping band

Stopaq outer wrapping band

How is it done?

- Reduce or eliminate the need of abrasive blasting, habitats
- Containing the existing hazardous coatings adherent to the surface, red lead
- Using a single component non-aging, non cross-linkable polymer, no VOCs
- Eliminating the need of high power diesel engines, compressors, heaters, emissions
- Reducing the amount of PPE, breathing apparatus, filters
- Reducing the strength of scaffolding, no abrasive weight to consider
- Increase productivity due to easy application in various climatic conditions
- Reducing waste and clean up, no hazardous remains

Mossmorran Area 11

Self-healing corrosion prevention & sealant systems

STOPAQ SEALFORLIFE