NTEPS 2019

Automation In Potentially Explosive Environments

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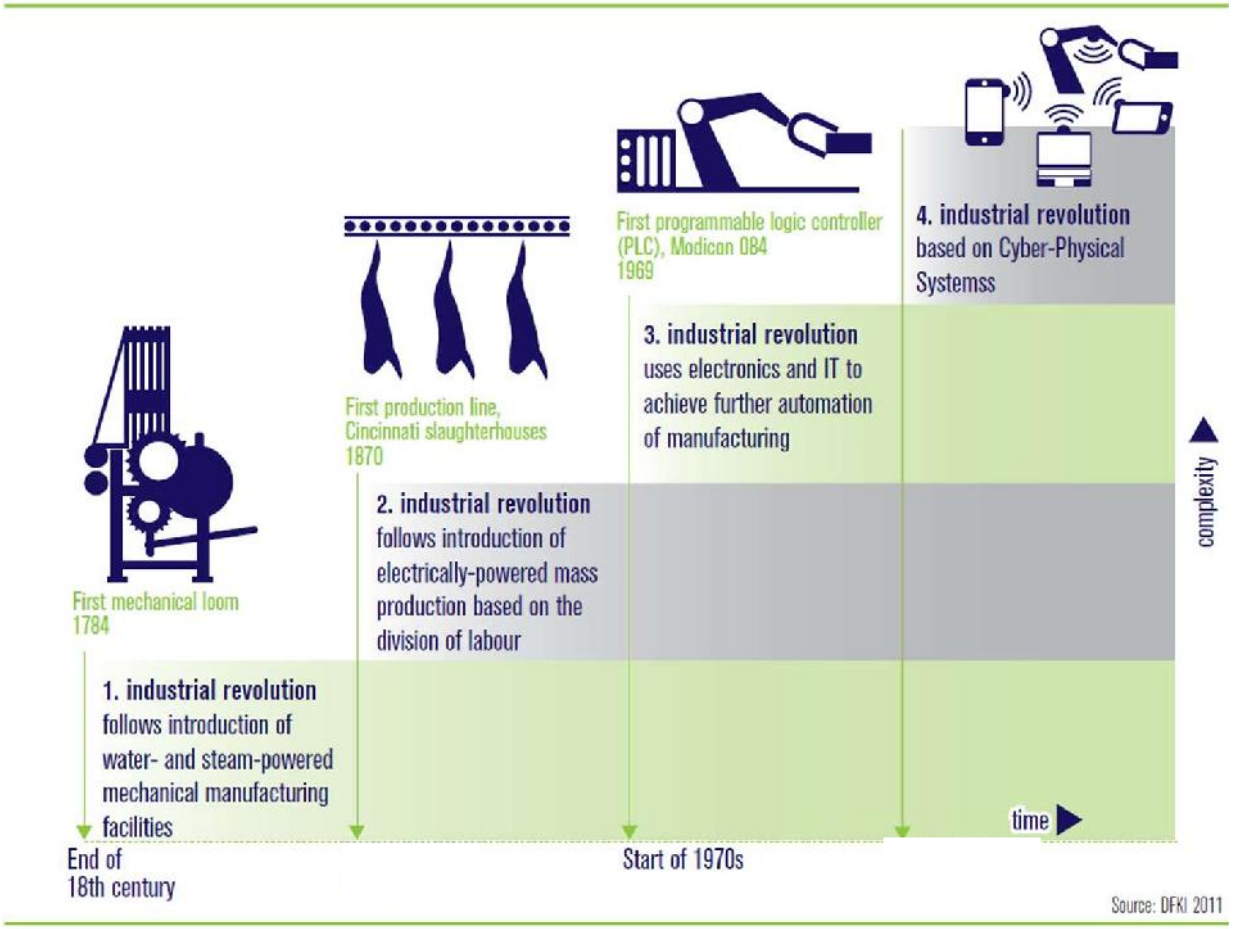
The Digital Transformation of Oil & Gas & HazLoc Risk

- Industry 4.0 definition
- Digital Overview and Opportunities
- Regulatory overview - Hazardous Location 101 / refresher
- Challenges

So what is Industry 4.0?



STEPs Digital Bingo

XaaS (SaaS)

A subscribed service rather than bought (As A Service) Software, Infrastructure,

Protocols

RFID, WiFi, BT, 5G, ZigBee NFC, LoRAWAN, Sigfox

IOT

Internet of Things

IIOT

Industrial Internet of Things

Fog

Taking the Cloud to the Edge

Edge

Devices at the Plant Level

Big Data

Big Data

Cloud

Someone else's computer

Digital Twin

Digital replica of a physical asset

Machine Learning AutoML

Machine learning is an application of AI systems to automatically learn & improve from experience w/o being explicitly programmed

Predictive Analytics

Statistical analysis of new and Historical Data to forecast activity, behaviors and trends

UX/UI

User Experience User Interface

Why do we need to Transform?

SAFETY

Repeatable, **R**eliable and **A**ccurate work

Create Augmented Operatives – Empowered to take on more work – SAFELY

More Time on Tools – Less fatigue due to Staff optimization

Risk Management & Insurance

Utilization of key SME's leveraging a staff base with a new culture for work

Some industry figures….

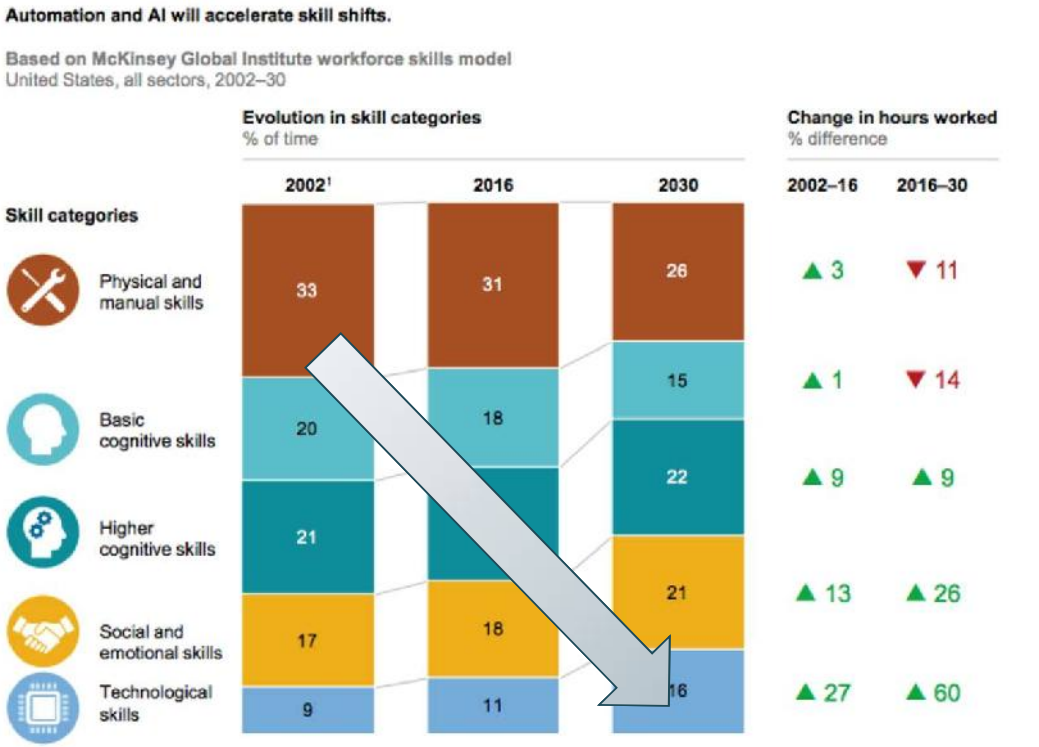


Image: McKinsey Global Institute

In the US – there will be a downward shift of 11% in the 90Bn Skilled Staff between 2016 and 2030.
This equal 17.2Bn less hours of skill horsepower available - that's 9MM people

The Technological, Engineering and People Skills sectors will rise by 20MM jobs

If the estimated 9MM from skilled jump to this sector…..
….**It leaves 11MM extra Technology jobs**
…to fill in 11 years

This is all fixable – but its not recruitment..

A new type of ‘Expert’

In the past - expertise was based on ***unconscious competency***...
‘She could do that job with her eyes closed’

With the ‘great crew change’ .. these competencies cannot be built because the people/coaches have retired

With mixed reality and some core skills... ***conscious competency*** wins... tasks will be executed with perfect repeatability... as close to being a **human robot** as you would want..

This is not a bad thing because with the that one person becomes empowered

Think about Automated Procedures and Workflows – Tracked, Auditable in real time remotely – only available to those with proven competencies. One SME for 1000’s of staff

Also – think of the benefits of training national staff internationally – visually – or simply translated in the local dialect

Increasing Risk…

So - We have a lot of new people, people from different technical backgrounds, and a lot of new equipment.

Risks in our industry may be new or different to the incoming resources.

There is a Tsunami of technology coming – a lot of the equipment will not be appropriately tested and certified for the appropriate location.

‘They don’t know what they don’t know’

The current legacy suppliers to industry are using this gap to relax diligence toward Testing and Certification.

Plausible deniability – ***‘The end user didn’t specify it – so it doesn’t need to happen’***

Example – HazLoc Risk Based Inspection

Product Data

+ Project Data

100% Digital RRA
Detailed &
Prescriptive
Validation

EPCM Stage
F.A.T. Stage

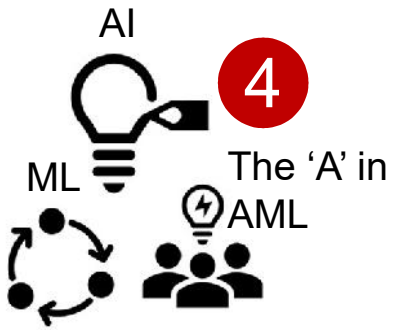
100% RRA In Situ
Simplified &
Prescriptive
Inspection

Commissioning
Stages
S.A.T. Stage

RRA Periodic
Simplified &
Prescriptive
Inspection

Reliability &
Maintenance Stage

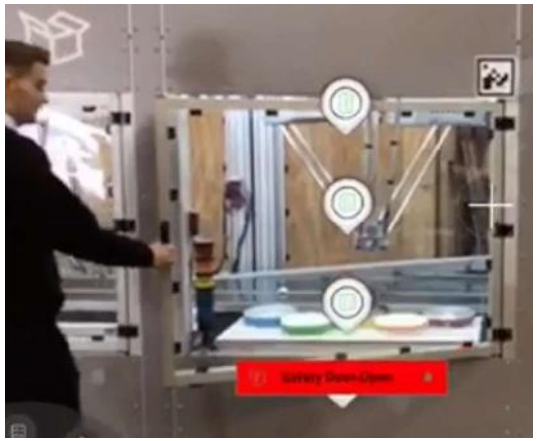
Product Intelligence



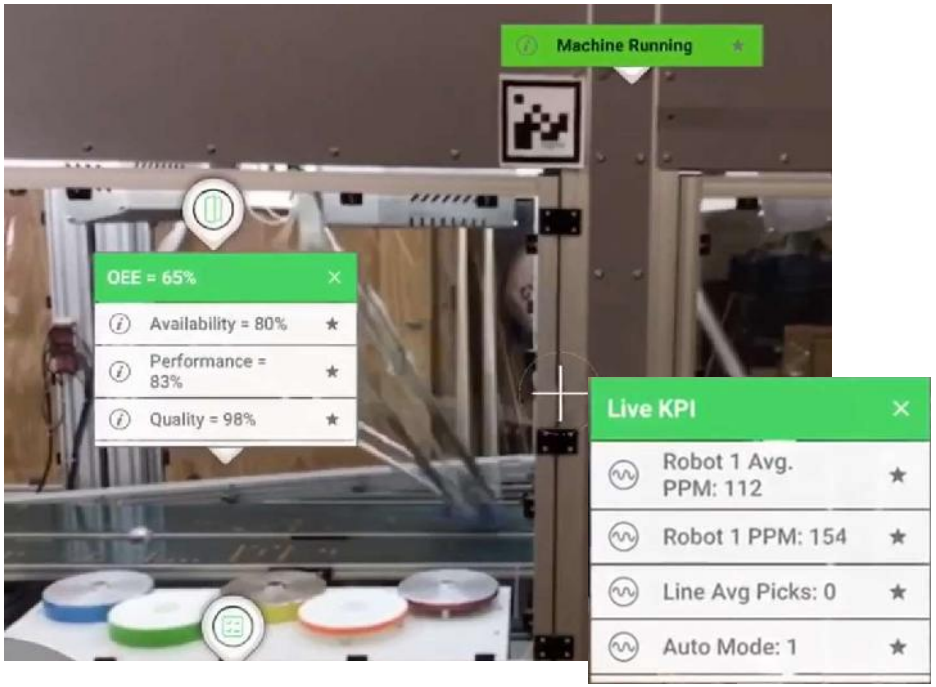
+/- 3/4/10 Years on the
Periodic Inspection
Safely and **Confidently**

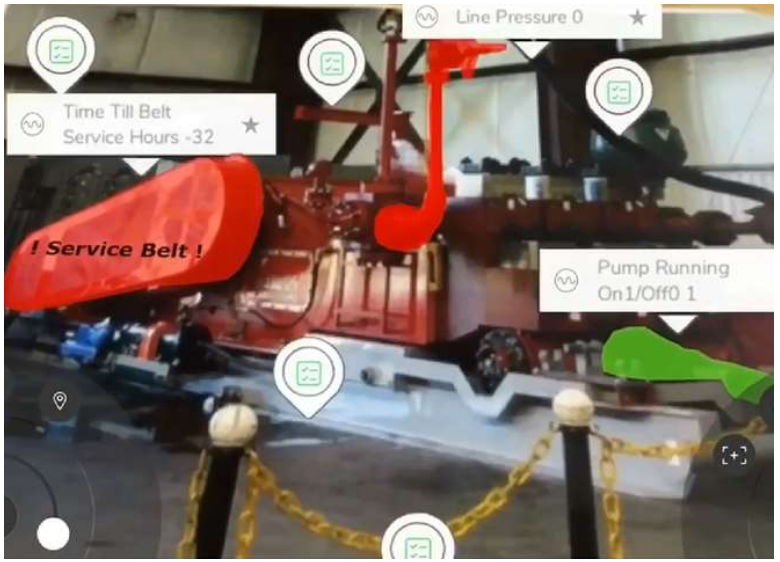
RRA – Repeatable, Reliable and Accurate

Example – Augmented Fault Finding



Example – Augmented Operations and Safety





HazLoc Basics

‘Ignition Source Management’

Empowering Trust™

Ignition source management is still a major source of property and casualty loss – and a focus of the Offshore communities

A Pemex-operated platform caught fire in the Gulf of Mexico on February 7, 2016 killing 4 and injuring 16

Hazardous locations

Potentially Hazardous Locations are dangerous places to work

Flixborough, UK – 1974 – 28 lives lost
Piper Alpha, North Sea – 1987 – 167 lives lost
Norco, LA – 1988 – 7 lives lost
Phillips, Pasadena TX – 1989 - 23 lives lost
Sterlington, LA – 1991 – 8 lives lost
Haysville, KS – 1998 – 7 lives lost
Philips K-Resin, TX - 2000 – 1 live lost
ICL Plastics, UK– 2004 – 9 lives lost
Texas City Refinery, TX – 2005- 15 lives lost
Georgia Sugar, GA – 2008 – 13 lives lost
Deepwater Horizon, TX – 2010 – 11 lives lost
West Texas, TX – 2013 – 15 lives lost
KMCO, TX - 2019 – 1 live lost

305 people, each one someone's Co-Worker, Colleague, Friend or Family Member

Getting worse?…..

KHOU 11 News is live now.
3 hrs ·

WATCH LIVE: A large fire at Intercontinental Terminals Company in La Porte continued to burn overnight, spreading to an additional six tanks, a company update says. That brings the total to 8 tanks burning. https://bit.ly/2OeRNqE
(Raw feed, no sound)

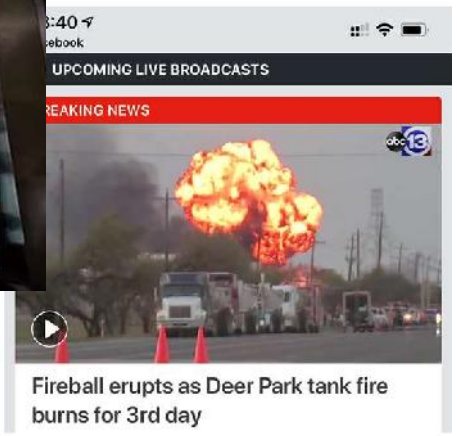
KHOU.com Staff - 8 minutes ago

SANTA FE, Texas - Several gas company contract workers in Santa Fe were injured when a gas line exploded and sent a column of fire into the air.

Eagle Ford Training San Antonio
2 mins ·

Workers were cleaning crude oil from the tank when it exploded.

KABB FOX 29 NEWS, SAN ANTONIO · 1 MIN...
ne dead in rail car tanker explosion
LMENDORF, Texas – One person was...



Fireball erupts as Deer Park tank fire burns for 3rd day

DWH April 2010

UNITED STATES COAST GUARD

Report of Investigation into the Circumstances Surrounding the Explosion, Fire, Sinking and Loss of Eleven Crew Members Aboard the MOBILE OFFSHORE DRILLING UNIT

DEEPWATER HORIZON

- **Hazardous Electrical Equipment:** At the time of the explosions, the electrical equipment installed in the "hazardous" areas of the MODU (where flammable gases may be present) may not have been capable of preventing the ignition of flammable gas. Although *DEEPWATER HORIZON* was built to comply with IMO MODU Code standards under which such electrical equipment is required to have safeguards against possible ignition, an April 2010 audit found that *DEEPWATER HORIZON* lacked systems to properly track its hazardous electrical equipment, that some such equipment on board was in "bad condition" and "severely corroded," and that a subcontractor's equipment that was in "poor condition" had been left in hazardous areas. Because of these deficiencies, there is no assurance that the electrical equipment was safe could not have caused the explosions.

DWH April 2010

UNITED STATES COAST GUARD

Report of Investigation into the Circumstances Surrounding the Explosion, Fire, Sinking and Loss of Eleven Crew Members Aboard the MOBILE OFFSHORE DRILLING UNIT

DEEPWATER HORIZON

As discussed in Chapter 1, this same audit found that [redacted] had failed to properly track and maintain its hazardous electrical equipment on the Drill Floor, that the equipment was in "bad condition," and that contractors had been allowed to leave equipment in poor condition on the Drill Floor. As a result, there is no assurance that such equipment did not ignite flammable gas to cause the explosions on April 20.

DWH April 2010

UNITED STATES COAST GUARD

Report of Investigation into the Circumstances Surrounding the Explosion, Fire, Sinking and Loss of Eleven Crew Members Aboard the MOBILE OFFSHORE DRILLING UNIT

DEEPWATER HORIZON

- **Hazardous Area Electrical Sources:** Flammable gas may have been ignited by unguarded electrical equipment in hazardous areas on or near the Drill Floor. (see additional discussion below)

Additional possible ignition sources include:

- **Temporary Electrical Circuits:** Another potential ignition source could have been temporary electrical circuits installed in hazardous areas on the Drill Floor to support current operations.

DWH April 2010

UNITED STATES COAST GUARD

Report of Investigation into the Circumstances Surrounding the Explosion, Fire, Sinking and Loss of Eleven Crew Members Aboard the MOBILE OFFSHORE DRILLING UNIT

DEEPWATER HORIZON

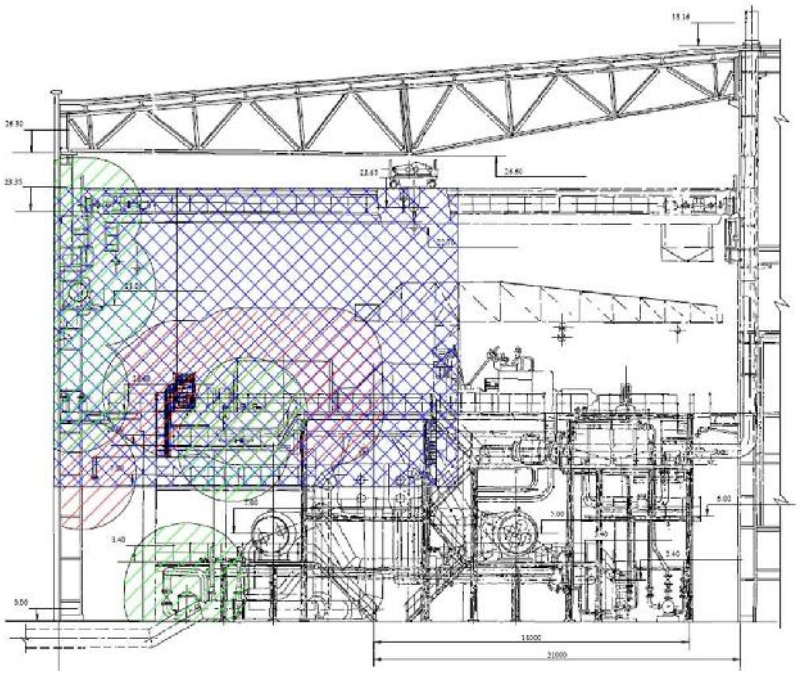
B. [redacted] **failed properly to track and maintain Drill Floor electrical equipment that could have served as an ignition source.**

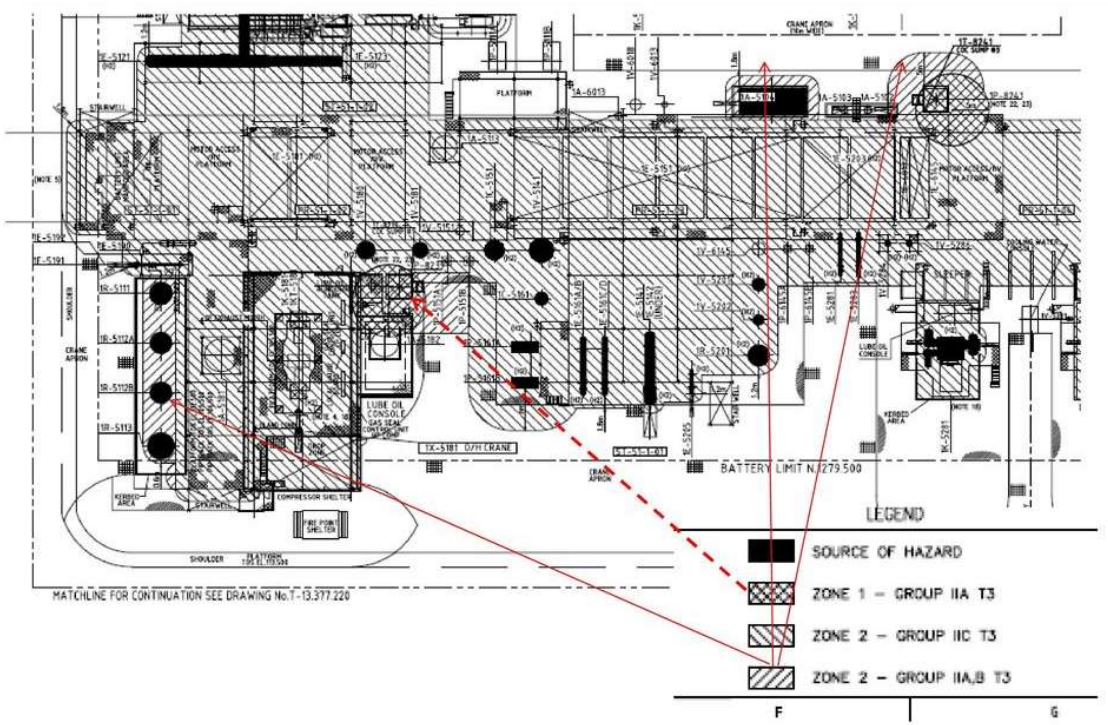
However, the April 2010 [redacted] audit found that *DEEPWATER HORIZON* lacked systems properly to track its hazardous electrical equipment and that the hazardous area electrical equipment on board was in "bad condition."[90] The audit determined that contrary to the IMO International Safety Management (ISM) Code,[91] none of the classified electrical equipment on the Drill Floor had been tagged with an identification number, and the MODU did not have on board a hazardous area equipment registry or hazardous area drawing that would have identified both the classified electrical equipment and the boundaries of the hazardous areas.[92] Since the crew did not have any means to clearly identify the classified electrical equipment or the extent of the hazardous areas, there can be no assurance that no unclassified fixtures were introduced into the hazardous areas during maintenance or modifications.

Industry has 3 considerations relating to compliance:

- PEOPLE
- PRODUCT
- PLACES

Area Classification Drawing





THE GLOBAL PRODUCT CERTIFICATION MARKETPLACE IS VOLATILE

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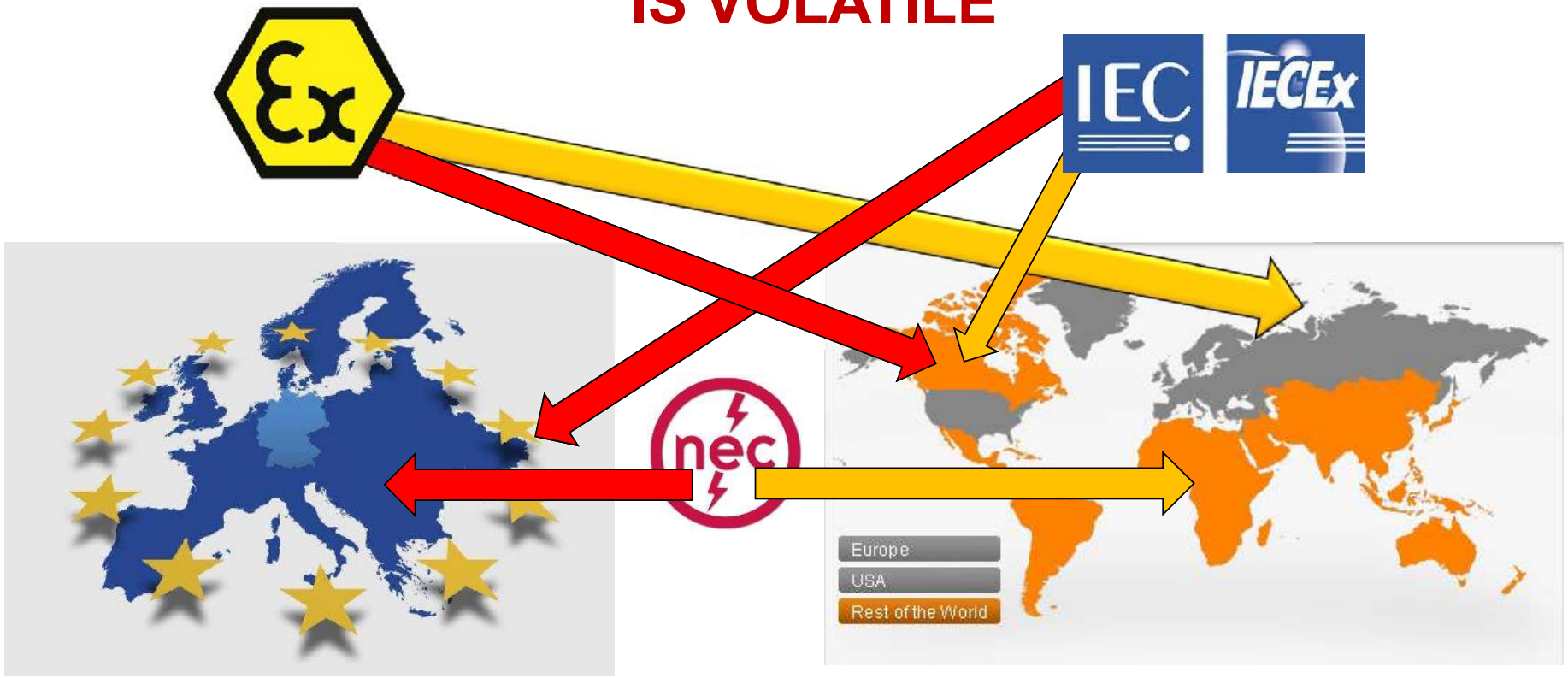


EUROPEAN UNION

ATEX and CE Marking will not go away in our careers….

….If you are shipping to Europe – it needs a CE mark

…..if it is going into a hazardous location in Europe – it needs an ATEX mark

- Also, other countries like ATEX, so don't be surprised if you get a request for ATEX outside of Europe.
- Any third party certification has be done by a Notified Body…..

ATEX – NON ELECTRICAL (LEGAL)

toxic fumes when using cleaning agents.

6.2 Maintenance schedule

It is recommended that
and schedule is adopted, in
Instructions, to include the follo
a) Any auxiliary systems
monitored, if necessary, t
correctly.
b) Check for any leaks fro
The correct functioning
be checked regularly.
c) Check bearing lubricant
run show a lubricant cha
d) Check that the duty c
operating range for the p
e) Check vibration, nois
temperature at the
satisfactory operation.
f) Check dirt and dust
around close clearance
motors.
g) Check coupling alignment

6.2.1 Routine inspection (daily/weekly)

CAUTION

The following checks should be made and the appropriate action taken to remedy any deviations:

a) Check suction and discharge gauges.
b) Check for abnormal operating conditions

6.2.2 Periodic inspection (monthly)

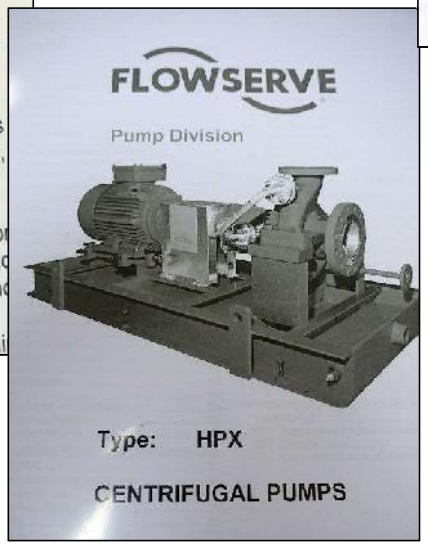
a) Check for lubricant contamination whether bearing oil, or seal oil (if applicable) by sample analysis.
b) Check all paint or protective coatings.
c) Check all power/instrument cable glands for tightness.

Refer to the manuals of any associated equipment for periodic checks needed.

6.2.3 Periodic inspection (six monthly)

a) CAUTION Check foundation bolts for security of attachment, corrosion. Check grouting for looseness, cracking or general distress.
b) Change lubricants.
c) Check calibration of instruments.
d) The coupling should be checked for correct alignment and worn driving elements.

Refer to the manuals of any associated equipment for periodic checks needed.



6.2.4 Inspection (after 3 years)

a) Check internal condition of pump and all ancillary pipework for corrosion/erosion.
b) Check internal pump components for wear.
c) Change bearings

4 INSTALLATION

Equipment operated in hazardous locations must comply with the relevant explosion protection regulations. See section 1.6.4, *Products used in potentially explosive atmospheres.*

5.7.3 Bearings

If the pumps are working in a potentially explosive atmosphere temperature or vibration monitoring at the bearings is recommended

If bearing temperatures are to be monitored it is essential that a benchmark temperature is recorded at the commissioning stage and after the bearing temperature has stabilised (see 5.2.4.1 for temperature limits).

4.9 Protection systems

The following protection systems are recommended particularly if the pump is installed in a potentially explosive area or is handling a hazardous liquid. If in doubt consult Flowserve.

If there is any possibility of the system allowing the pump to run against a closed valve or below minimum continuous safe flow a protection device should be installed to ensure the temperature of the liquid does not rise to an unsafe level.

ATEX MECHANICAL CERTIFICATION

CE MARKING – LEGAL REQUIREMENT

If a manufacturer falsely CE marks a product or fails to CE mark a product for which it is required, the maximum penalty is three months in jail and a £5,000 fine for the director of the offending company.

THERE ARE SYNERGIES IN THE REQUIRMENTS

	North America Art. 500 (c UL us)	ATEX	IECEx
Can other Schemes be used for Certification	Yes; A valid IECEx report can be used along with US/CAN deviations to obtain a Listing	Yes; A valid IECEx report can be used along with EN deviations to obtain a Type Certificate	Limited acceptance of other scheme's test data

The North American mainland is pretty straightforward

- Labels and Stickers or…
- Approval from an AHJ – Authority Having Jurisdiction
- Usually installed by electrical craft not focused on packages or systems

505.9 Equipment.

(A) Suitability. Suitability of identified equipment shall be determined by one of the following:

(1) Equipment listing or labeling

(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation

(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

Interpreting the Markings – Divisions

If certified:

- *NRTL / certification agency mark*
- *Typically a traceability marking (e.g. file or certificate number)*
- *Typically a product identity (e.g. "Tank Monitoring Equipment for Use in Hazardous Locations")*

Warning markings

Reference to manual, control drawing, etc. as applicable

Ambient temperature range

- *if other than -25°C to +40°C (per the NEC)*

Types of International Certificates

Certificate of Conformity

- *Complete equipment*
- *May cover a series*
- *May contain Special Conditions of Safe Use*

Certificate of Component

- *Incomplete equipment*
- *May cover a series*
- *Will include a Schedule of Limitations or Conditions of Component*

HAZARDOUS AREA CLASSIFICATION

Customer - “ Please provide a product for IECEx and ATEX Zone 1 plus Class 1 Div 1 “

You can’t!!

There are four elements to product specifications..

1 - Likelihood of the gas been present – that’s

2 – The Gas and/or Dust Group of the hazardous area of installation (IIA, IIB, IIC, IIIA, IIB, IIIC)

3 - The Ignition Temperature of the hazardous gas – The temperature or T class (T1 – T6)

4 – The ambient temperature of the location to be used (Standard cert is -20^{o}C to +40^{o}C)

EQUIPMENT PROTECTION LEVELS - IECEX

Zone	IEC Class	ATEX Category	IEC EPL
0	II	1G	Ga
1	II	2G	Gb
2	II	3G	Gc
20	III	1D	Da
21	III	2D	Db
22	III	3D	Dc
	I	M1, M2	Ma, Mb

THE UNICORNS PROBLEM

Testing and Certification for Class and Division can be different from Class and Zone…

Also - Div 1 is comparative with Zone 0 – You can buy a Div 1 squirrel cage motor but not a Zone 0 one.

Subtle differences trip cause some pitfalls in achieving the unicorn…

Selecting the right components at the front end design and ideation phase is key

… a subtle change in a PCB design may miss a compliance opportunity…

(ref: IEC 60079-11 Ex ‘i’ from IEC 60079-15 Ex ‘nL’)

HazLoc Technical compliance requirements differ internationally

…so if you were developing a ‘global’ product

… what compliance model would you choose?

US Offshore Regulatory Frameworks

- Two groups talk about collaboration on regulations but the output is still not fully aligned.
- The USCG has released regulatory information regarding IECEx
- BSEE are working on their strategy

But - the USCG opened up the minds of the regulators

The USCG recognizes that equipment certified under the ATEX scheme could have been through third party approvals

BUT, the supporting document to their new regulation says:

The Coast Guard.. Will not accept ATEX certification because evidence of full testing to the applicable harmonized 60079 series of standards by a third-party laboratory is not guaranteed

Now in force

DEPARTMENT OF HOMELAND SECURITY

Coast Guard

33 CFR Parts 140 and 143

46 CFR Parts 110 and 111

[Docket No. USCG–2012–0850]

RIN 1625–AC00

Electrical Equipment in Hazardous Locations

AGENCY: Coast Guard, DHS.

ACTION: Final rule.

DATES: This final rule is effective April 30, 2015.

April 2nd 2018

SUMMARY: The Coast Guard is issuing regulations applicable to newly constructed mobile offshore drilling units (MODUs), floating outer continental shelf (OCS) facilities, and vessels other than offshore supply vessels (OSVs) that engage in OCS activities. The regulations expand the list of acceptable national and international explosion protection standards and add the internationally accepted independent third-party certification system, the International Electrotechnical Commission System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEx), as an accepted method of testing and certifying electrical equipment intended for use in hazardous locations. The regulations also provide owners and operators of existing U.S. MODUs, floating OCS facilities, vessels other than OSVs, and U.S. tank vessels that carry flammable or combustible cargoes, the option of following this compliance regime as an alternative to the requirements contained in existing regulations.

Anything missed?

Electrical Equipment Inspection and Maintenance Requirements

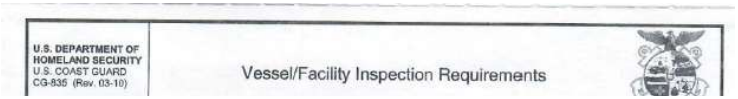
Five comments recommended that the Coast Guard establish standards for the design, installation, inspection, and maintenance of electrical equipment in hazardous locations. Two comments suggested requiring an onboard electrical equipment register that contains information regarding electrical equipment and its inspection, maintenance, and operational history. The commenters also suggest this information could be reviewed by visiting Coast Guard marine inspectors or third-party inspection personnel and could become part of a company's quality system. We agree that competency and accurate recordkeeping are critical to safety, but this recommendation is outside the scope of this rulemaking.

- US based compliance is heavily based on PRODUCT compliance
- There was an opportunity to leverage the competency requirements of the IECEx standards

People

- So the critical factor comes back to the human's.
- People who 'don't know what they don't know' is on the rise
- Hazardous Location compliance is at risk – it is a very specialized subject from electrical design to maintenance.
- There are industry schemes to train to a '10' level through to discrete design classes – Online in learning management systems through to practical week long classes.
- Training should cover EVERY stakeholder – Sales, Design, QA/QC, Engineering Management, C-suite – otherwise buy in to the extra expense is difficult.
- Digital Solutions are available!

Diligence is increasing



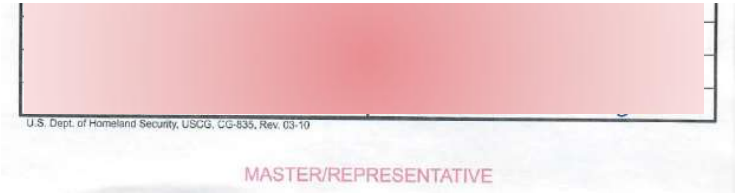
ANNEX

INTERIM GUIDELINES ON SAFETY FOR NATURAL GAS-FUELLED ENGINE INSTALLATIONS IN SHIPS

8.3.4 Any personnel that should carry out inspections and maintenance of electrical installations in explosion hazardous spaces should be qualified pursuant to IEC 60079-17, item 4.2.

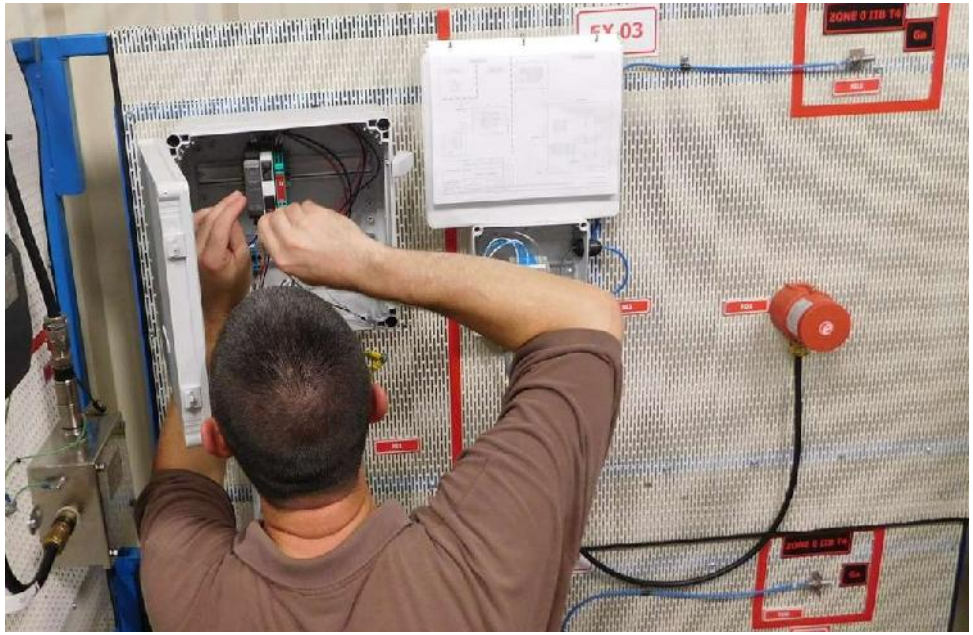
***

[18] Refer to IEC 60079-17:2007 Explosive atmospheres – Part 17: Electrical installations inspection and maintenance.



Example – HazLoc Competency

Are the regulators ready?



- Lieutenants
- Lieutenant Commander
- Commanders
- Civilian Inspectors
- Technicians