

## LAWRENCE BLACKMORE – Functional Safety and C&I Engineering

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EXPERIENCE:	General	Functional Safety, Process Control and Safety Systems, Fiscal Metering,
	Job functions	Functional Safety Management Functional Safety and Fiscal Metering Services C&I Engineering and Design Deliverables Package Engineering & Management Specification and Procurement
	Specialisms	Functional Safety (IEC61511), Fiscal Metering
	Process areas	Oil & Gas, Petrochemicals, Power, Water.
EMPLOYMENT: HIGHLIGHTS (last 35 yrs)	2018 - ongoing 2018 - ongoing 2014 - 2018 2001 - 2013 1998 - 2001 1997 –1999 1994 –1997 1988 –1994	Golar LNG Norway, FS Support FLNG Gimi Bumi Armada, FPSO Kraken, Operations FS TA BW Offshore, FPSO Catcher, FS manager and metering support SBM Offshore Monaco, FS and Metering Group Technical Authority British Oxygen, C&I/metering specialist engineer Tarmac/Black & Veatch, C&I Manager McDermott Engineering (London) Chief C&I Engineer British Petroleum, Re-instrumentation Project Manager

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PROFESSIONAL:	Eur Ing, C Eng, Fellow IET, Fellow Inst Measurement & Control TUV registered Functional Safety Expert and Trainer. Inst MC Registered Functional Safety Engineer
QUALIFICATIONS:	HONOURS DEGREE, CYBERNETICS & INSTRUMENT PHYSICS
YEAR OF BIRTH:	1949
PROFILE:	<p>I have been working in the petrochemical and power generation control and instrumentation field for over 45 years, holding positions with major engineering contractors and operators. This included a long period with BP and then head of the C&amp;I department for a major London contractor.</p> <p>In 1997 I started working as an independent supplier of specialist functional safety and metering services including training and consultancy. In 2001 I established a long term relationship with SBM Offshore (Monaco), a major designer, supplier and operator of offshore Floating Production, Storage and Offloading vessels (FPSO's) providing project and operational FS and metering support across their four world-wide offices, a full-time contract role that continued to 2013. The activities included the production of the group's functional safety corporate procedures, metering corporate procedures, and holding the role of Technical Authority for both FS and metering.</p> <p>After 2013 I returned to the UK and continued to provide specialist metering and functional safety services to SBM and to other major international clients.</p>

DETAILS (Last 30 years):

GULFTREAM ENGINEERING (own company): July 2013 -

POSITION: DIRECTOR

DUTIES: Specialist services to various clients in the field of IEC61511 functional safety including implementation planning and management, SIL assessment, SIL validation, SRS production, Functional Safety Assessment, training. Specialist fiscal, custody transfer and allocation metering support services.

Functional Safety Activities since 2013

Golar LNG	FLNG Gimi (contract, part-time)	8/18 ongoing	GLNG Project FS Manager
Bumi Armada	FPSO Kraken (contract, part-time)	2/18 ongoing	Ops FS TA
BW Offshore	FPSO Catcher (contract, part-time)	10/14 to 9/18	Project FS Manager and FS deliverables, and operations support.
BW Offshore	Corporate	12/14	Corporate FS procedures
AMEC Abu Dhabi	ADMA/OPCO Umm Lulu Complex	10/15	FS Consultancy
AMEC London	BP Baku	9/14 to 12/14	Project FS support
AMEC London	Dana UK Offshore Project	6/14 to 9/14	Project FS support
AMEC London	Corporate	3/14 to 6/14	Corporate FS procedures
Technica	LNG Terminal, Pakistan	1/14	SIL assessment chairman
DNV Korea for SK Engineering	Onshore chemicals project	11/13	SIL assessment chairman
Safety Critical Software Portugal	Corporate	5/13	IEC61508 training
Amec/Gaz de France	UK offshore project	1/13 – 11/13	SIL assessment chairman for 5 assessment sessions
SBM Offshore	TUV certified FS Eng training	4/13 – 11/19	9 courses at all SBM locations
SBM Monaco	FPSO OX2 Brazil	7/13 – 9/13	SIL assessment, validation and SRS production for non-API instrumented protection functions
SBM Monaco	All FPSO fleet	10/13	Chairman of fleet-wide relief risk assessment study
SBM Rotterdam	FPSO Cidade de Ilhabela	9/14	FSA stage 3
SBM Kuala Lumpur	SBM Group technology development division	11/13 – 3/15	Design study for full IEC61511 SIS implementation, to evaluate system and operational cost implications.
SBM Houston	FPSO Shell Stones	8/13	SIL Assessment Support

METERING ACTIVITIES since 2013

SBM Kuala Lumpur	Consultancy support for FPSO Mero 2	2/20 - ongoing	Specialist metering consultancy
Bumi Armada	FPSO Kraken (contract part-time)	4/18 – 12/18	Ops metering TA
BW Offshore	FPSO Catcher (contract, part-time)	10/14 – 12/18	Regulatory compliance support for FPSO Catcher
SBM Monaco	FPSO's Cidade de Marica/Saquarima, Metering package engineer (2 x \$7m packages)	7/13 - 5/16	Specification, package management, compliance assurance. Full PKE support up to regulatory audits in Brazilian yard and sail-away
SBM Houston	FPSO Shell Stones	7/14 - 12/14	Metering support to lead engineer

SBM Offshore, MONACO: March 2001 - June 2013

POSITION: GROUP TECHNICAL AUTHORITY & LEAD C&I ENGINEER (contract)

DUTIES: Group Corporate Technical Authority for Functional Safety and for Metering Systems across the company's offices in Monaco, Rotterdam, Kuala Lumpur and Houston, including support to operations

Produced the SBM Group Corporate Engineering Standards for Metering, Flow Measurement and for Instrumented Safety Systems (IEC61508/61511)

In addition to the Group Corporate activities I also acted as Lead C&I engineer on three projects and metering package engineer on nine projects. The package engineer role involved the production of all relevant C&I procurement and design deliverables such as specification and bid evaluations, and vendor document review.

<u>ES</u>		
Monaco	Development of SBM Group Corporate Engineering Standard for IEC61511 application, as Group Technical Authority	2003 and on-going revisions
Rotterdam	Talisman MOPU SIL assessment and FS management	2007 - 2008
Monaco	FPSO Shell Espirito Santo SIL assessment and FS management	2009 - 2010
Kuala Lumpur	MOPU Encana (Canada) SIL assessment and FS management	2009
Monaco	FPSO Okha Woodside, FS management	2010
Kuala Lumpur	FPSO N'Goma, SIL assessment	2011
Monaco	BP Quad turret, FS management	2012
<u>METERING</u>		
Monaco	Development of SBM Group Corporate Engineering Standard for metering, as Group Technical Authority	2003 and on-going revisions
Monaco	Discipline Lead C&I Engineer, FPSO Brasil	2002 - 2004
Monaco	Discipline Lead C&I Engineer, FPSO Sanha Turret	2003
Rotterdam	Metering PKE for FPSO Marlin Sul	2003 - 2004
Rotterdam	Metering PKE for FPSO Capixaba	2005 - 2006
Kuala Lumpur	Metering PKE for FPSO Kikeh	2005 - 2007
Houston	Metering PKE for FPSO Frade	2006 - 2008
Monaco	Talisman MOPU Lead C&I engineer for subsea mooring system	2007 - 2008
Rotterdam	Metering PKE for FPSO P57	2008 - 2009
Monaco	Metering PKE for Shell FPSO Espirito Santo	2009 - 2010
Monaco	Discipline Lead C&I engineer for Shell Prelude FLNG turret	2010 - 2011
Houston	Metering PKE for FPSO Baleia Azul	2010 - 2011
Rotterdam	Metering PKE for FPSO Cidade de Paraty	2011 - 2012
Rotterdam	Metering PKE for FPSO Cidade de Ilhabela	2011 - 2013

BRITISH OXYGEN COMPANY: 1998 – 2001

POSITION: LEAD CONTROL AND METERING SYSTEMS ENGINEER (contract, part-time)

DUTIES: Provision of specialist control/safety system and fiscal metering expertise to manage BOC's EPC design contractor for a very large (1\$B) air separation and 400MW combined cycle power plant project in Mexico. Duties include acting as technical contract authority, review and approval of specifications, supplier progress management, installation and commissioning procedures, and direction of the factory and site acceptance testing. I was also involved setting up maintenance procedures, and training of local operations staff in fiscal metering.

The control systems consist of a Foxboro I/A main DCS, interfacing with some 13 other package or subsidiary systems. These include a remote SCADA system for offshore pipelines, and the package systems for turbine and compressor control. I also supervised the three very large custody transfer gas metering packages, including design approval, uncertainty analysis, and the preparation of the metering dossier for approval by the Certifying Agency.

I continued to provide on-going operations support through the first year of production.

TARMAC/BLACK & VEATCH: 1997 – 1999

POSITION: CONTROL & INSTRUMENTATION ENGINEERING MANAGER (contract, part time)

DUTIES: Technical and commercial authority for TBV's control and instrumentation activities in power generation and water treatment projects and tenders. I supervised a small group of TBV engineers, and a major part of the work was subcontract management. Projects included:

Zeneca Grangemouth ETP – SCADA system with 4 PLC's  
Finham Treatment Plant – SCADA system with 32 PLC's  
Shell Green Treatment Plant – SCADA systems  
Barry CCGT Power – Bailey DCS commissioning

To assist in TBV's transition from civil/infrastructure projects to complex M&E scopes, I developed company design and procurement procedures, and worked extensively on EPC M&E tenders in power generation and water treatment.

McDERMOTT ENGINEERING: 1994 - 1997

POSITION: CHIEF CONTROL AND INSTRUMENTATION ENGINEER (staff)

DUTIES: McDermott's manager of C&I across all projects including supervision of project lead engineers, engineering design, procurement, technology development and company procedures. The main areas of activity were offshore oil and gas production, and power generation. I reported to the Head of Engineering and had typically a group staff of 25 engineers and designers.

Projects undertaken included:

BP Harding platform  
BP Foinavon FPSO  
Elf Elgin/Franklin platform  
Premier Power Ballylumford power station  
National Power Pembroke power station upgrade.  
QGPC Qatar, PS1 field engineering services contract.

A significant part of my responsibilities included supporting the development group, devising proposal strategies for new offshore and power generation projects and taking part in client presentations. I also spent two months in Qatar setting up a multi-discipline engineering design team for an offshore engineering services contract for Occidental Petroleum.

BP ENGINEERING: 1988 - 1994

POSITION: REINSTRUMENTATION AND PROJECT MANAGER (staff)

DUTIES: Seconded to various British Petroleum sites to manage large scale reinstrumentation and development projects. This was full turn-key authority for budget, programme and performance, including startup and commissioning. Workscopes included design, procurement, installation and commissioning. The projects were:

BP Llandarcy Refinery reinstrumentation and advanced control, pneumatic to DCS, including extensive analyser packages and an expert system. I reported to the refinery manager, and ran a project team of 10-15 engineers and designers. The systems were a main TCS Maxivis control system (including a Linkman expert system and a multi-variable model based advanced control package), and a PLC based protection system.

BP Kinneil (Grangemouth) Forties Crude Oil Stabilisation and Gas Plant - upgrade of control, shutdown, analyser and fire & gas systems, including live changeover from panel to DCS. I reported to the Forties Asset Manager, and led a team of on average 15 engineers and designers. The control system was a Honeywell TDC3000, with a Triconex safety system and a GP Elliott Fire and Gas system. It also included the replacement of the 35-stream fiscal metering system with new Spectra-Tek equipment. Also required was the construction of a new control room and the relocation of operation whilst the plant was live. The project was phased over 3 years.

BP Dalmeny Tanker Loading Terminal - provision of very large tanker loading metering facilities. I reported to the Dalmeny Asset Manager and led a small team of on average 10 engineers and designers. The scope included the urgent manufacture in a short timescale of a very large metering skid, for simultaneous metering and loading to two tanker jetties. There was a very large mechanical and construction content to the project. In addition there was the supply of a Spectra-Tek control and metering system for the loading operations.

BABCOCK CONTRACTORS LIMITED: 1985 - 1988

POSITION: PRINCIPAL CONTROL SYSTEMS ENGINEER (staff)

DUTIES: Responsible for BCL's team of control systems engineers. The group's activities included the specification, evaluation and selection of a wide range of control systems, followed by associated contract management and engineering. Application areas included nuclear, fine chemicals and oil/gas processing, and equipment ranged from small PLC's to large Distributed Systems. My time was also spent on proposal work, developing bidding strategies. I also acted as lead engineer on several projects, including one every large nuclear application with a Fisher Provox DCS.

## OTHER INFORMATION:

EDUCATION: READING UNIVERSITY, 1968 - 1971  
UPPER 2ND HONOURS DEGREE, CYBERNETICS & INSTRUMENT PHYSICS

PROFESSIONAL: REGISTERED CHARTERED EUROPEAN ENGINEER  
FELLOW, INSTITUTION OF ELECTRICAL ENGINEERS  
FELLOW, INSTITUTE OF MEASUREMENT AND CONTROL  
TUV REGISTERED FUNCTIONAL SAFETY EXPERT & TRAINER  
Inst MC REGISTERED FUNCTIONAL SAFETY ENGINEER

### TECHNICAL PAPERS PRESENTED:

COMPUTER CONTROL OF AMMONIA PLANTS	1977	(Inst MC)
DIGITAL BATCH SEQUENCE CONTROL	1978	(Inst MC)
INDUSTRIAL MICROPROCESSOR APPLICATIONS	1978	(Seminar)
ENERGY CONSERVATION THROUGH ADVANCED CONTROL	1979	(Inst MC)
DE-COUPLING AN INTERACTIVE TEMPERATURE PROCESS	1980	(Seminar)
CALIBRATION OF COMPUTER BASED METERING SYSTEMS	1983	(Seminar)
MANAGING A COMPUTER BASED CONTROL SYSTEM PROJECT	1987	(Inst MC)
RETRO-FITTING CIM ON LIVE PROCESS PLANT	1993	(Seminar)
INTEGRATING CONTROL & SAFETY SYSTEMS	1995	(Seminar)
CATEGORISATION OF CONTROL AND SAFETY SYSTEMS	1995,	1997 (IEE)
FIELDBUS - MANAGING THE CONTRACTORS RISK	1997	(Seminar)
IEC 61508 AND THE DESIGN CONTRACTOR	1998	(Seminar)
IEC 61508 – ITS EFFECT ON YOUR BUSINESS	1999	(ISA Italy)
CURRENT PROBLEMS IN IEC61508 IMPLEMENTATION	2000	(ISA Holland)
IEC61508 – ITS AFFECT ON SYSTEMS SUPPLIERS	2000	(ISA Italy)
PROBLEMS IN IEC61508 SIL ASSESSMENTS	2000	(ISA USA)
CHAIRMAN – CONFERENCE ON IEC61508	2002	(ISA UK)
IMPLEMENTATION OF IEC61508 ON AN FPSO	2003	(Seminar)
IEC61508/61511 DESIGN FOR RISER OVER-PRESSURE PROTECTION	2003	(IEE)
DESIGN OPTIONS FOR OVER-PRESSURE PROTECTION ON A MULTI-RISER FPSO	2012	(Inst MC)
HYBRID APPLICATIONS OF IEC61511 WHERE OTHER DESIGN CODES APPLY	2014	(TUV & Inst MC)
FUNCTIONAL SAFETY MANAGEMENT PROBLEMS ON A REAL LIFE PROJECT	2016/7	(Inst MC)

### CONTACT DETAILS:

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