

FUNDAMENTALS OF NUCLEAR POWER

Exploring nuclear power today and tomorrow:
technology, operations, economics,
safety and decommissioning

SAVE up to 40% and improve performance
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DELIVERED BY DISTANCE LEARNING OVER 12 WEEKS

Course Programme

- 1 Introduction to Nuclear Power: Terminology, History, Technical Basics and the Current State of the Industry
- 2 Nuclear Power Stations: Operations and Maintenance
- 3 The Nuclear Fuel Cycle
- 4 Nuclear Safety
- 5 Decommissioning, Public Perception and Accident Analysis
- 6 Future Developments and Challenges

COURSE DIRECTOR:

Bill Sooby BA, MBA, CEng, Eur Ing
Consultant, LNG2020 Ltd

*"Appraises arguments for both
building new and optimising existing
plants"*

*"A valuable mix of technical essentials
and global industry issues"*

IDEAL FOR:

- **Power and energy employees** aiming for a more specialised career focus
- **Staff in companies supporting or newly engaging** with the nuclear sector
- **Nuclear company personnel** seeking broader knowledge of the entire industry
- **Legal, financial and insurance professionals** related to the energy sector
- **Consultants** coming to projects involving nuclear issues
- **Government officials** in energy and environmental portfolios

**CPD
21
hours**

**CEUs
2.1**

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Enquiries tel: +44 (0)20 7017 7209
+1 (646) 957 8929

Visit: www.ibc-academy.com/fnp

Dear Colleague,

After a period of decline and stagnation, **nuclear power** was set for a resurgence. Since Fukushima, confidence has been shaken, with some countries shifting focus from new builds to extending the life or increasing the efficiency of existing plants. The fact remains, however, that the world needs more than hydrocarbons and renewables for its current and future energy needs, and emerging economies in particular are planning significant investments in new reactors. **Low carbon forms of power generation** are needed if emission limits are to be met and nuclear power stations are a reliable means of meeting this requirement.

Whether adopting a 'make do and mend' approach, progressing with new builds or even shutting down reactors altogether, one thing is clear: **in many countries around the world, there is a pressing need for nuclear know-how.**

The nuclear power industry is complex and capital intensive. It is a **specialised field** which **demand a good understanding** of its unique challenges and opportunities. Nuclear energy is controversial and all those connected to the industry, directly or indirectly, need a clear understanding of the central issues and arguments involved.

This training course provides thorough underpinning knowledge to **demystify every aspect of the nuclear industry.** This is a **non-technical programme**: any technical terms that are used will be introduced and explained simply and clearly. One of the aims of the course is to allow you to **speak the language of the nuclear industry** even if you have no technical or scientific background.

Whether you need an **operational or commercial grounding**, or simply a **comprehensive overview** of all the key issues, the Fundamentals of Nuclear Power will be indispensable to your engagement with this vital sector. **Six clearly written and richly illustrated modules** develop your understanding of the industry, starting with a technical and historical introduction and progressing to a detailed description of how nuclear power stations work. The fuel cycle is examined, and the crucial issues of nuclear safety analysed, as well as the implications of accidents. The principles and practices of decommissioning are addressed, finishing with an appraisal of the future of nuclear energy.

Studying the nuclear power industry by distance learning gives you the **freedom to learn while you work.** There's no need to travel to attend seminars. All materials are delivered to you online, and you have full access to expert tutorial support and peer networking via an online forum. You can work at your own speed, at a time that is convenient to you and can review the training materials as often as you wish.

This **clear and complete explanation** of a complex energy sector will give you the knowledge you need to work in or alongside the nuclear power industry, delivering a critical link in the global energy demands of the future.

I look forward to welcoming you on the course.

Bill Sooby BA, MBA, CEng, Eur Ing
Course Director

HOW DOES THE COURSE WORK?

The course starts on **Tuesday 20th March 2012** which is the first day that course access will be available.

Modules are released one every two weeks over the 12-week duration of the course.

Each student receives their own username and password to access our secure site and materials can be accessed from wherever they have an internet connection. The modules can be downloaded as PDF files and they can save them to their computer as well as print them out if they want to study whilst they are on the move.

Once a student has completed the study of each module in a two week period, they then sit an online test in order to check their understanding. All tests must be passed by the end of the course. Those who successfully complete all six tests will be awarded a certificate of completion from IBC Academy for CPD purposes.

ADVANTAGES OF DISTANCE LEARNING

Increasingly, we all face more pressures in our business lives. Finding time to attend courses of any kind can be very difficult and well meant plans are often put aside indefinitely.

Distance learning can be the solution to your training needs. You can enjoy the full benefits of studying, whilst still in employment using this freedom and flexibility to study around your other commitments.

DELIVERED BY



IBC Academy delivers high quality training to the ports, logistics, energy, environment and safety industries, assisting individuals and organisations to achieve goals by developing skills, knowledge and performance. We address the growing need for professional training in specific industry areas by providing open and in-house learning and training solutions, delivered by leading industry experts.
www.ibt-academy.com

COURSE DIRECTOR



Bill Sooby BA, MBA, CEng, Eur Ing

Bill Sooby has a degree in Physics and a MBA, and has worked in the energy industry for over 30 years. He is a member of the UK Nuclear Institute and is a Chartered Engineer with European engineer (Eur Ing) status. He has experience in the oil and gas business as well as over a decade of operational and technical experience in the nuclear industry. He left his previous employer, Shell, in 2007 and since then he has been working as an independent consultant, as well as bringing his training and expertise to IBC Academy.

His nuclear experience of both operational and safety issues consists of employment at Bradwell and Dungeness 'B' nuclear power stations in the UK and in a headquarters safety role assessing the safety of new nuclear systems. He has extensive experience of preparation and assessment of nuclear safety case documentation. Bill's working experience covers gas-cooled reactors (both Magnox and Advanced Gas Reactors) and fast reactor technologies. He has also assessed the safety issues around the dry storage of spent nuclear fuel.

He held a series of posts of increasing seniority and responsibility in the nuclear industry. A primary function of his work was the preparation of nuclear safety documentation, including:

- Authoring documents for the Nuclear Safety Committee and managing their proposals through the assessment process.
- Drafting and managing the approval process, including supporting arguments, for changes to the Power Station Operating Rules and Instructions.
- Assessing the nuclear safety implications of proposed plant modifications.
- Preparation of Stage Clearance documentation supporting increases in allowed power levels as part of the commissioning process at Dungeness 'B'.

To do this work Bill developed safety arguments for both senior management and the statutory authorities in the UK. This included the use of large-scale, sophisticated computer models to specify safety systems and operating limits.

He was a member of the nuclear emergency standby team and managed a small team of graduate engineers and support staff.

On joining the oil and gas industry Bill pioneered the use of Quantified Risk Assessment techniques in the downstream Liquid Petroleum Gas industry, transferring these tools from the nuclear to the non-nuclear field. Subsequently, he worked in commercial roles in the gas and power businesses.

COMPANIES THAT HAVE ALREADY BENEFITED FROM IBC ACADEMY'S DISTANCE LEARNING PROGRAMMES INCLUDE:

A. P. Moller Maersk • Acergy Services Ltd • Addax Petroleum Services • Aegean Energy SA • Agency Ltd • Alldco S R O • AMEC Business Consulting • Ariel Reinsurance • Bagerngas Norge A/S • Bank PHB Plc • Barbados National Oil Company Ltd • BG Group • BOC Gases • Boskalis Offshore • BP • Brodies LLP • Centrica plc • Chevron Texaco • Daewoo Nigeria Ltd • E.ON Ruhrgas • Enereco • ESSO Exploration Angola Ltd • Fugro Ltd • Gaslink Nigeria Ltd • Gasunie • Germanischer Oil & Gas • Helix Energy Solutions BV • Industry Canada • JOGMEC • JP Morgan Chase • Lion Petroleum Pty Ltd • Lloyds Banking Group • Maersk Oil • Ministry of Energy and Mineral Development, Uganda • MR Offshore Navigation • National Grid Plc • Oil Spill Response Ltd • Omnibus Integrated Resources Ltd • Oryx Oil Company Ltd • Petrasco • Petro Mekong Corporation • Petron Corporation • Phoenixite Offshore Nigeria Ltd • Pipeline Integrity Engineers • Principia • Qatar Gas • Qatar General Petroleum Corporation • Ruiise Underwater Engineering • Saith Ltd • Saudi Arabian Texaco Inc • Sevan Marine • Shell Petroleum • South African Government • SPT Group • Statoil Asa • Subsea 7 • Suez-Tractebel • TD Williamson Offshore Services AS • Thomson Reuters Point Carbon • Total E&P Nigeria • Trinidad and Tobago Ministry of Energy and Energy Affairs • U.S. Department of Energy • Woodside Energy Ltd

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COURSE SYLLABUS

Module One

Introduction to Nuclear Power: Terminology, History, Technical Basics and the Current State of the Industry

- Introduction and principles
- Key terminology
- The basics of a nuclear reactor
 - The atomic nucleus
 - Nuclear fission
 - Key elements of the reactor
- A brief history of nuclear power
 - The first nuclear reactor
 - Early reactors – military and first generation civil
 - The development of the civil nuclear industry
- The state of the nuclear power industry worldwide
- Two key events: Three Mile Island and Chernobyl
- Decline of the industry 1980s – 2000s
- Potential renaissance as a low-carbon form of generation
- Problems today
 - Costs
 - Shortage of experienced personnel
 - Public acceptance
 - The effect of Fukushima

Module Two

Nuclear Power Stations: Operations and Maintenance

- The rationale for new builds
 - Carbon dioxide emissions
 - Economics
 - Capital costs
 - Nuclear power within competitive power pricing systems
- How a nuclear power station works
- Units and terms used in power generation
- The Nuclear Island
 - The reactor
 - Essential plant located immediately around the reactor
 - The control room
- The conventional side
 - Steam turbine
 - Condenser and feed-water
 - Alternator
 - Power delivery to the grid
- Operational issues
 - Baseload operations
- Maintenance activities

Module Three

The Nuclear Fuel Cycle

- Sources of nuclear fuel
 - Reserves to production ratio
- Mining
- Enrichment and fuel fabrication
 - Mixed oxide fuels
- Refuelling
- Reprocessing
 - Plutonium: how it arises and what it could be used for
 - Issues around plutonium
- Nuclear waste
 - Transport
 - Storage
- Long term availability of nuclear fuel

- Uranium prices
- The myth of 'peak uranium'

Module Four

Nuclear Safety

- Introduction to nuclear safety
 - Radiation and contamination
 - Health effects of radiation
 - Exposure limits
- High level overview of nuclear safety principles
 - Redundancy
 - Segregation
 - Diversity
 - Defence in depth
 - Role of the operator
- Emergency planning and exercises
- Regulatory issues
 - International Atomic Energy Agency (IAEA)
 - Non-proliferation issues

Module Five

Decommissioning, Public Perception and Accident Analysis

- Decommissioning
 - Principles
 - Practice
 - Case study: Berkeley Power Station, UK
 - Decommissioning of nuclear facilities unconnected with power generation
- Public perceptions of nuclear power
 - The safety record in the nuclear industry
 - Risk vs. perception
- The effect of some early accidents
- Analysis of major reactor accidents
 - Three Mile Island
 - Chernobyl
 - Fukushima
 - Impact on public opinion and political decision-makers

Module Six

Future Developments and Challenges

- New reactor types
 - Reactor 'generations'
 - Reactors under construction or 'market ready'
- Other reactor types
 - Fast reactors
 - Pebble bed reactors
 - Thorium-fuelled reactors
 - Fusion reactors
- Siting issues
 - Proximity of water and power grid
 - Risks to populations
- Challenges facing the nuclear power industry
 - Political
 - Environmental
 - Economic

INTERESTED IN AN IN-COMPANY OR CUSTOMISED DELIVERY OF THIS COURSE?

This course can be delivered directly to your company or organisation by distance learning or instructor led workshops whilst including a range of additional benefits to meet your specific business objectives:

- **Customised delivery** - additional company focused content, case studies and examples
- **Blended learning** - incorporating workshops, online tutoring, additional assessment and skills training
- **Flexibility** - scheduled to suit your requirements
- **Support** - dedicated staff providing required progress reporting

To find out more about the benefits of Corporate Training and how distance learning can be a cost effective means of achieving your training goals, telephone **+44 (0)20 7017 4455** or email **ibc-academy.ct@informa.com**.



OTHER COURSES:

- Fundamentals of Global Energy
- Fundamentals of Renewable & Alternative Energy
- Oil & Gas MBA (with Middlesex University)
- Fundamentals of Oil & Gas
- Fundamentals of Petroleum Economics
- Fundamentals of Pipeline Engineering

For a full list of our other training courses visit us online at **www.ibc-academy.com** or email **ibc-academy@informa.com**

TERMS AND CONDITIONS

1. APPLICATIONS To apply for a place on the Course (as defined below) either complete the relevant application form ("Application Form") or apply online. Your application is an offer to IBC Academy (a trading division of IIR Limited) ("IBCA") to study on the course as set out in the Application Form ("the Course") which is subject to IBCA's (and any associated academic partner's) acceptance. A binding contract between IBCA and you will only be formed when written confirmation of acceptance (which may be sent by email) is sent by IBCA to you.

2. PAYMENT You must pay to IBCA the fees set out in the Application Form. Payment of any invoice must be received by IBCA in full and in cleared funds, by the due date set out on the invoice or at least seven days before the start of the Course, whichever is sooner. Please note that non-payment of fees will result in the withholding of any Course materials due to be provided as part of the Course ("the Course Materials") and IBCA may charge you interest on any overdue fees at the rate of 2% per annum above National Westminster Bank Plc's base lending rate from time to time. You may pay by (i) Visa, MasterCard, Diners Club or American Express; (ii) a cheque made payable to IIR Ltd; or (iii) bank transfer. On banking, if paying by your credit card details will be required to confirm your application. No charge will be taken at this point, but if you fail to pay any invoice in full and on time, we will charge the card for any outstanding sums.

3. TAXES The fees stated are exclusive of any applicable VAT, sales, service or similar taxes (which will be charged, where applicable, at the appropriate rate as at the date of invoice). Where payment is subject to a withholding tax the student will apply the reduced rate under the appropriate double tax treaty, if applicable, and agree to provide IBCA with a certificate of tax deduction within three months of payment. If a certificate of tax deduction is not provided within three months, you will become immediately liable to pay the outstanding amount.

4. PARTICIPANT CANCELLATION POLICY You may cancel your place on the Course by giving notice in writing to the Course Administrator within 7 days from the date IBCA confirms your acceptance to the Course in accordance with Condition 1 and you will not be liable for the payment of any fees and any fees already paid to IBCA for the Course will be refunded. If IBCA receives your notice of cancellation 8 days or more from the date IBCA has confirmed your acceptance to the Course you will still receive a refund of your fees already paid to IBCA, subject to payment by you to IBCA of a £175 cancellation fee to cover administrative costs (which shall be payable immediately upon your cancellation), provided such notice of cancellation is received by IBCA before the first day of the Course. IBCA regrets that no refunds can be given for any cancellation notice it receives on or after the first day of the Course and, in

such circumstances, the full fees remain payable by you to IBCA.

5. COURSE CANCELLATION, RE-SCHEDULING AND ALTERATIONS IBCA reserves the right to cancel or change the dates of the Course. IBCA may offer you the option of participating in any re-arranged comparable Course that IBCA chooses (in its sole discretion) to organise. If you choose not to participate in any re-arranged Course or if IBCA does not organise such a Course then you will (as your sole remedy) be entitled to receive either a credit note or a refund in respect of the fees received from you by IBCA. IBCA reserves the right to make non-material alterations and/or amendments to the Course as in its reasonable opinion it considers to be in the best interest of the Course (including, without limitation, any non-material alteration to the Course or the scope of the Course) without liability.

6. INTELLECTUAL PROPERTY IBCA owns or is licensed all intellectual property rights in the Course and Course Materials. You acknowledge and agree that any Course Materials which are provided to you may only be used solely for your own private, non-commercial use. You may not reproduce, transmit, distribute, resell, sub-license, rent, lease, transfer or attempt to assign the rights in or commercially exploit or use the Course Materials, alter or create derivative works from the Course Materials or otherwise use or exploit the Course Materials other than as expressly permitted in this Condition 6.

7. ENTIRE AGREEMENT You and IBCA ("the Parties") acknowledge that these terms and conditions, together with your application form, constitute the entire agreement between the Parties ("Agreement") in relation to the Course and that neither Party relies upon any oral or written representation made to it by the other Party. No variation of this Agreement shall be effective unless made in writing signed by or on behalf of each of the Parties to this Agreement.

8. GOVERNING LAW AND JURISDICTION This Agreement will be governed by the laws of the England and disputes under or in connection with them shall be subject to the non-exclusive jurisdiction of the English courts.

9. LIMITATION OF LIABILITY IBCA's liability for losses you suffer as a result of IBCA breaching this Agreement or otherwise in connection with the Course is limited to those losses that are a foreseeable consequence of IBCA breaching this Agreement. Losses are foreseeable where they could be contemplated by you and IBCA at the time IBCA accepted you onto the Course. To the extent that IBCA is liable for such losses, IBCA's total liability will only extend to the fees paid by you to IBCA under the Agreement. In addition, IBCA shall not be responsible for any indirect losses which happen as a side effect of the main loss or damage which are not foreseeable by IBCA. For the avoidance of doubt, nothing in this section 9 shall limit or exclude IBCA's liability for: (i) death or personal injury resulting from

negligence or (ii) fraud or fraudulent misrepresentation; (iii) any breach of IBCA's obligations implied by section 12 of the Sale of Goods Act 1979 or section 2 of the Supply of Services and Services Act 1982; (iv) any losses for which it would be legal or unlawful for IBCA to exclude or attempt to exclude its liability.

10. SEVERANCE If any provision of this Agreement (or any part of any provision) is found by a court or other authority of competent jurisdiction to be invalid, illegal or unenforceable, that provision or part-provision shall, to the extent required, be deemed not to form part of this Agreement and the validity and enforceability of the other provisions of this Agreement shall not be affected.

11. WAIVER No failure by either Party in exercising any right, power or remedy shall operate as a waiver of the same.

12. FORCE MAJEURE IBCA shall not be deemed to be in breach of this Agreement or otherwise be liable to you as a result of any delay or failure to perform its obligations if and to the extent that such delay or failure is caused by a force majeure event (this means any event arising that is beyond the reasonable control of IBCA, including but not limited to, any industrial dispute, health scares or epidemics, tutor, consultant or participant cancellation or withdrawal, venue damage or cancellation, governmental regulations or action, fire, flood, disaster, civil riot, acts of terrorism or war). If the period of delay or non-performance continues for 3 months, either party may terminate this Agreement by giving 14 days' written notice to the other party and any fees already paid to IBCA for the Course will be refunded.

13. DATA PROTECTION AND CALL MONITORING Personal data supplied is subject to the Data Protection Act 1998. The personal information shown on the application form, and/or provided by you, will be held on a database and may be shared with companies in the Informa Group in the UK and internationally. This information may be used for direct marketing purposes. If you do not wish your details to be available to companies in the Informa Group, please contact the Database Manager, tel: +44 (0)20 7017 7077, fax: +44 (0)20 7017 7828, email: integrity@ihc.co.uk. Occasionally your details may be obtained from, or made available to, carefully selected external companies for marketing purposes. If you do not wish to receive details about their products and services, please contact the Database Manager, Registered in England No. 1835199, VAT registration number GB 365 4626 36, IIR Ltd, Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK. Telephone calls to IIR Ltd will be recorded or monitored to check the quality of the service provided.

Apply online at www.ibc-academy.com/fnp

FUNDAMENTALS OF NUCLEAR POWER

DELIVERED BY DISTANCE LEARNING OVER 12 WEEKS

Commences 20th March 2012

VIP CODE:

FLR2246EMAG

IBCA/SW/KR/HM/TR/TR

Course Code
FLR2246

The nuclear power industry needs knowledge. Get yours - enrol now.

5 EASY WAYS TO REGISTER

Online: www.ibt-academy.com/fnp
 Email: helen.murray@informa.com
 Tel: +44 (0)20 7017 4763
 Fax: +44 (0)20 7017 7861
 Mail: ATTN: Helen Murray
 IBC Academy
 6th Floor, 29 Bressenden Place
 London
 SW1E 5DR
 UK

Are we mailing you correctly?
 To update your contact details on our database please visit www.updates.informa.com

Note: Participants will be billed in either GBP or USD depending on the price option selected. The GBP invoice will include a EUR price calculated using the exchange rate in force on invoicing.

STEP 1: WORK OUT THE PRICE – Please tick option

Fundamentals of Nuclear Power	Book on or before 3 rd February 2012	Book after 3 rd February 2012
UK Individual or UK Company	<input type="checkbox"/> £1349 + VAT @ 20% (269.80) = £1618.80	<input type="checkbox"/> £1449 + VAT @ 20% (£289.80) = £1738.80
EU Individual or EU non-VAT Registered Company	<input type="checkbox"/> £1349 + VAT @ 20% (269.80) = £1618.80	<input type="checkbox"/> £1449 + VAT @ 20% (£289.80) = £1738.80
EU VAT Registered Company (VAT number must be quoted in Step 2 below to qualify)	<input type="checkbox"/> £1349 (No VAT to pay)	<input type="checkbox"/> £1449 (No VAT to pay)
Individual or Company outside the EU	<input type="checkbox"/> £1349 (No VAT to pay) OR <input type="checkbox"/> US \$2185 (No VAT to pay)	<input type="checkbox"/> £1449 (No VAT to pay) OR <input type="checkbox"/> US \$2350 (No VAT to pay)

STEP 2: PARTICIPANT DETAILS – Please photocopy form for multiple bookings

1. Participant (Mr/Mrs/Ms/Miss/Dr/Capt) Family name _____ First name _____
 Job title _____ Company _____
 Address _____
 City _____ Postcode/Zip code _____
 Country _____ Mobile _____
 Direct telephone _____ Fax _____
 Preferred email _____ VAT number _____

2. Who is your Training Manager? (Mr/Ms) Family name _____ First name _____
 Job title _____ Direct telephone _____
 Email _____


3. Who is your Approving Manager? (Mr/Ms) Family name _____ First name _____
 Job title _____ Direct telephone _____
 Email _____

4. How did you hear about the course? _____

STEP 3: PAYMENT DETAILS — You will be charged in GBP or US\$ as selected in Step 1. The GBP invoice will include a EUR price calculated using the exchange rate at time of invoicing.

1) I wish to pay by: **Credit Card** Please charge the credit card below **Bank Transfer** **Cheque**

A credit card guarantee is required. Please complete the card details below. The details will be securely stored and no charge will be taken at this point. An invoice for payment will be provided. If the invoice is not paid by the due date, we reserve the right to charge the card for any outstanding sums. We will advise you (using your email address provided) in advance of charging the card.

Card Type: VISA MasterCard  AMERICAN EXPRESS Please charge my credit card in: GBP USD EUR (CVV: last 3 digits on signature strip on back of credit cards. Amex: 4 digit number on the front of the card)

Card no. _____ Expiry date __ / __ / __ CVV Number _____ Signature _____

Cardholder's name _____ Contact tel no _____

Card billing address _____

2) Cheques should be made payable to IIR Ltd and please write your name and the reference FLR2246 on the back. Bank transfer details will be provided on the emailed invoice.

I have read the Terms & Conditions as outlined on the course brochure and agree to adhere to them.

Signature _____ Date __ / __ / __