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**Nuclear Labour Markets:
the Challenges of Workforce Planning**

MURPHY Brian

*University of Salford Department of Nuclear Energy, NE
Joule House Acton Square, The Crescent Greater Manchester
Manchester M5 4WT
UNITED KINGDOM*

Nuclear Labour Markets: the Challenges of Workforce Planning

Dr Brian P Murphy

Head, Academic Development, HR Development

EC - EHRO-N

OECD - NEA

UK – Nuclear Skills Council



IAEA-ICTP

Joint School of Nuclear Energy Management
Trieste


12th November, 2012

Structure

1. The Global Context
2. A Nuclear Test!
3. Challenges of Nuclear Labour Markets
4. Solutions to Nuclear Labour Markets
 - Core, Boundaries, Anatomy
5. Quantifying and Qualifying HR
6. Projecting Future HR Demand
7. Strength in Numbers - International Cooperation & Development
8. Stepping Up – HR Planning and Competence
9. Final Steps – HR Planning and Knowledge Management
10. Conclusions- Characteristics of a Healthy Labour Market

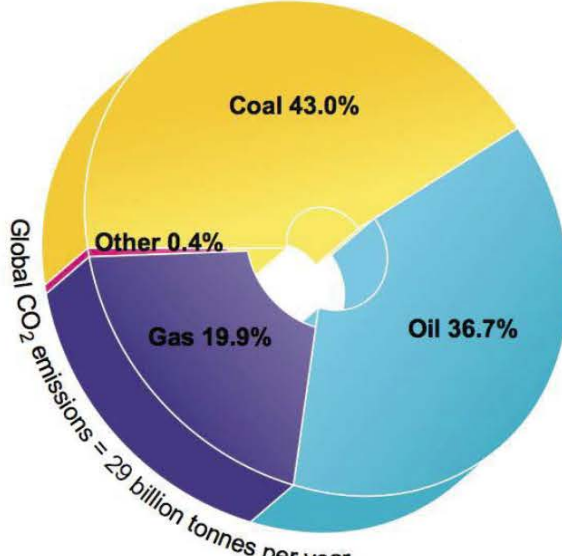
1. Global Context

2012 WNA Pocket Guide



World Nuclear Association

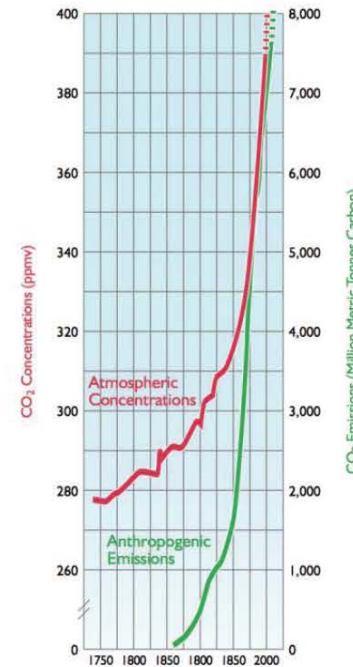
NUCLEAR POWER, ENERGY AND THE ENVIRONMENT



Global CO₂ emissions = 29 billion tonnes per year

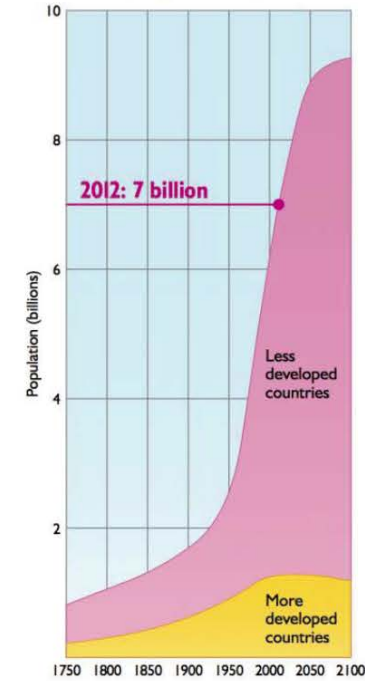
www.world-nuclear.org

CO₂: Anthropogenic emissions and atmospheric concentrations



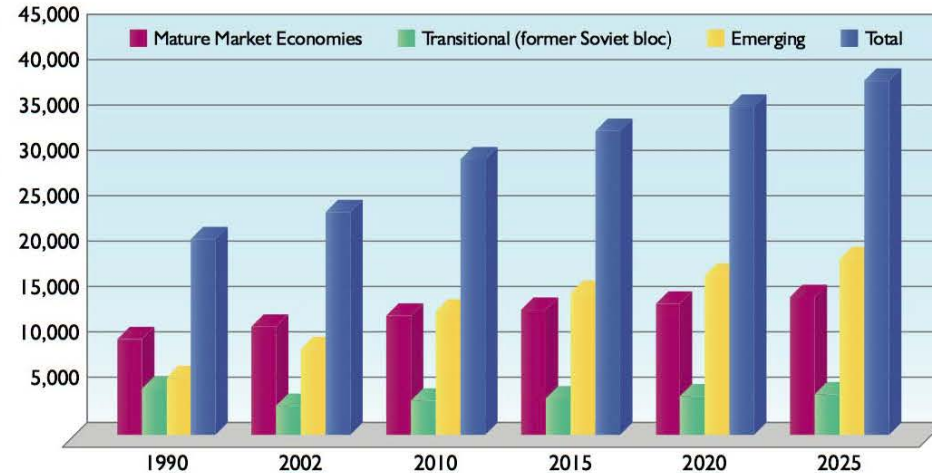
Source: Oak Ridge National Laboratory

World population growth



Sources: United Nations, World Population Prospects
The Population Reference Bureau

Source: US Energy Information Administration



World CO₂ emissions

2. A Nuclear Test – Match the Stats!

- 371,422
- 30
- 13
- 436
 - 272
 - 84
 - 47
 - 16
 - 15
 - 2
- 14,870
- 1956
- ????????
- % Electricity production in 2011
- Reactor years of experience
- Nations with > 400 MWe
- MWe Global Capacity
- Reactors in operation
- First commercial generation
 - LWGRs
 - BWRs
 - PHWRs
 - PWRs
 - FBRs
 - AGRs

2. A Nuclear Test – the Answers

- 371,422 MWe
- 30 Nations with > 400 MWe
- 13% Electricity 2011
- 433 Reactors in operation
 - 272 PWRs
 - 84 BWRs
 - 47 PHWRs
 - 16 AGRs
 - 15 LWGRs
 - 2 FBRs
- 14,870 Reactor years of experience
- 1956 First commercial generation (Calder Hall)
- ???????? The size of the global nuclear force



3. Challenges for Nuclear Labour Markets

- Recruitment
- Defining the Labour Market Supply and Demand
- Establishing Workforce Development Frameworks
- Mobilising Education and Training Provision
- Internationalisation
- Knowledge Management & Mobility of Human Capital

4. Solutions – the Core of a Nuclear Labour Market is...



Beehive Parliament
Wellington, NZ

4. Solutions – the Boundaries of a Nuclear Labour Market

1. Policy & Regulation
 - licence to operate



2. Safety Health, Environment
 - legal and statutory

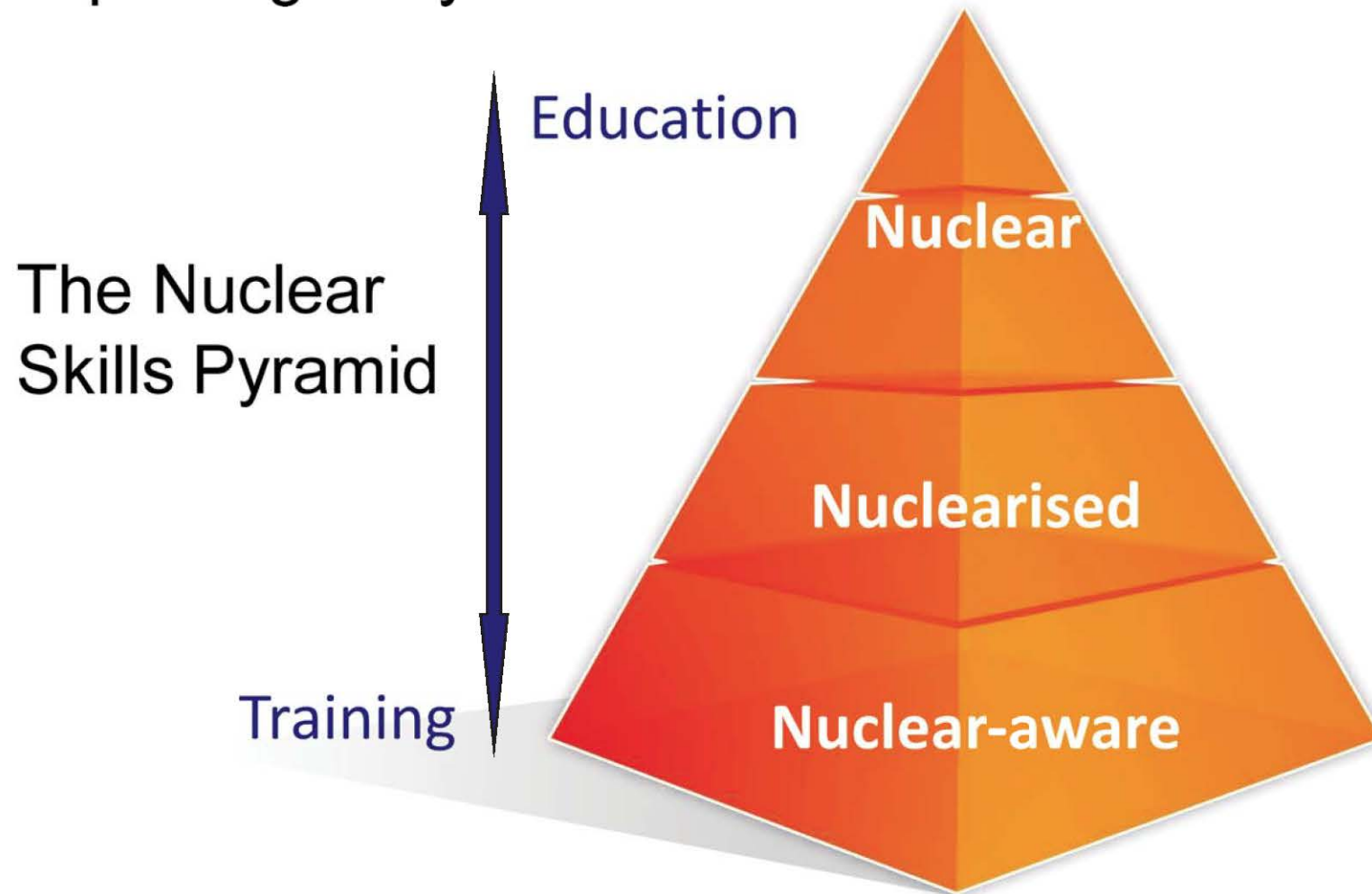


3. Scientific & Technical Competence
 - professionalisation

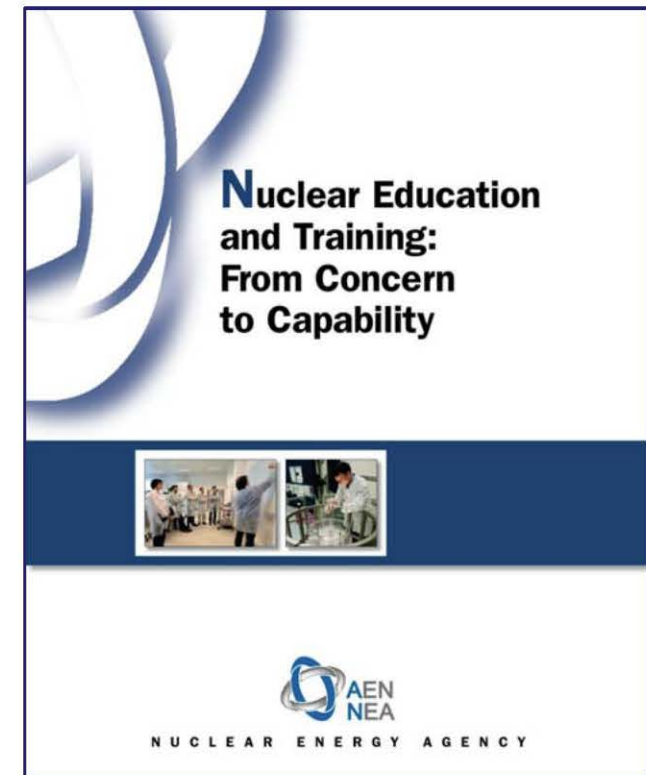
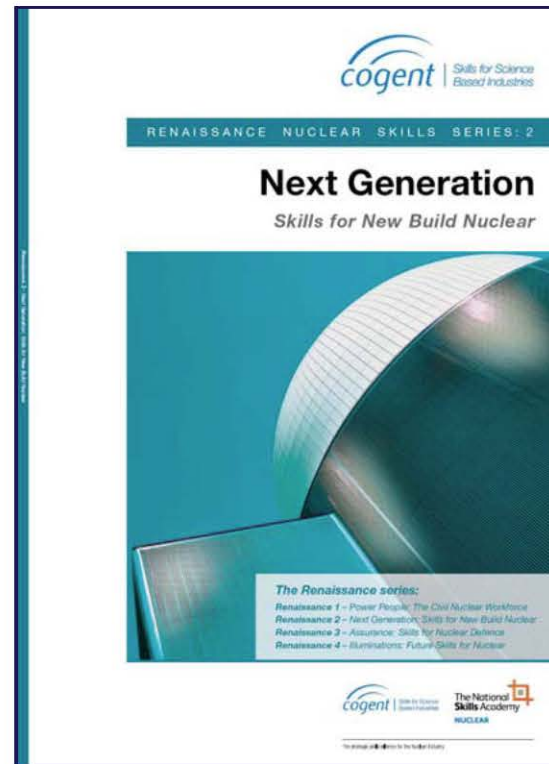
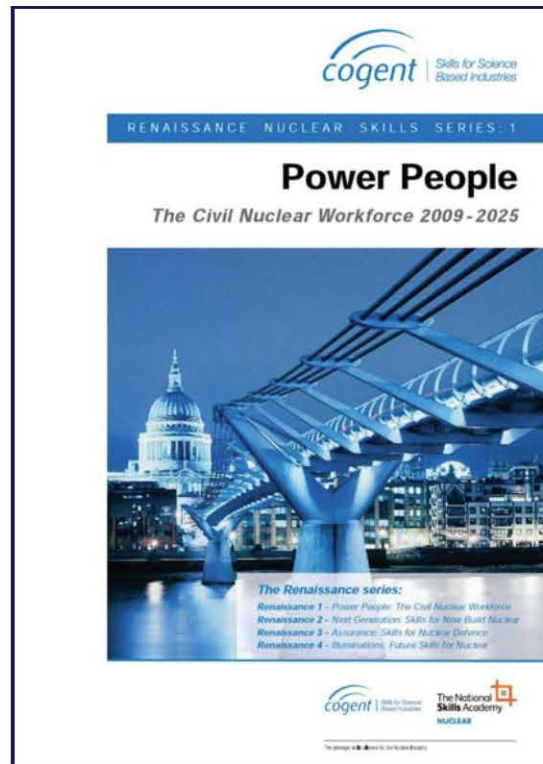


4. Solutions – the Anatomy of a Nuclear Labour Market

Exploding a myth...



5. Quantifying and Qualifying HR



Power People

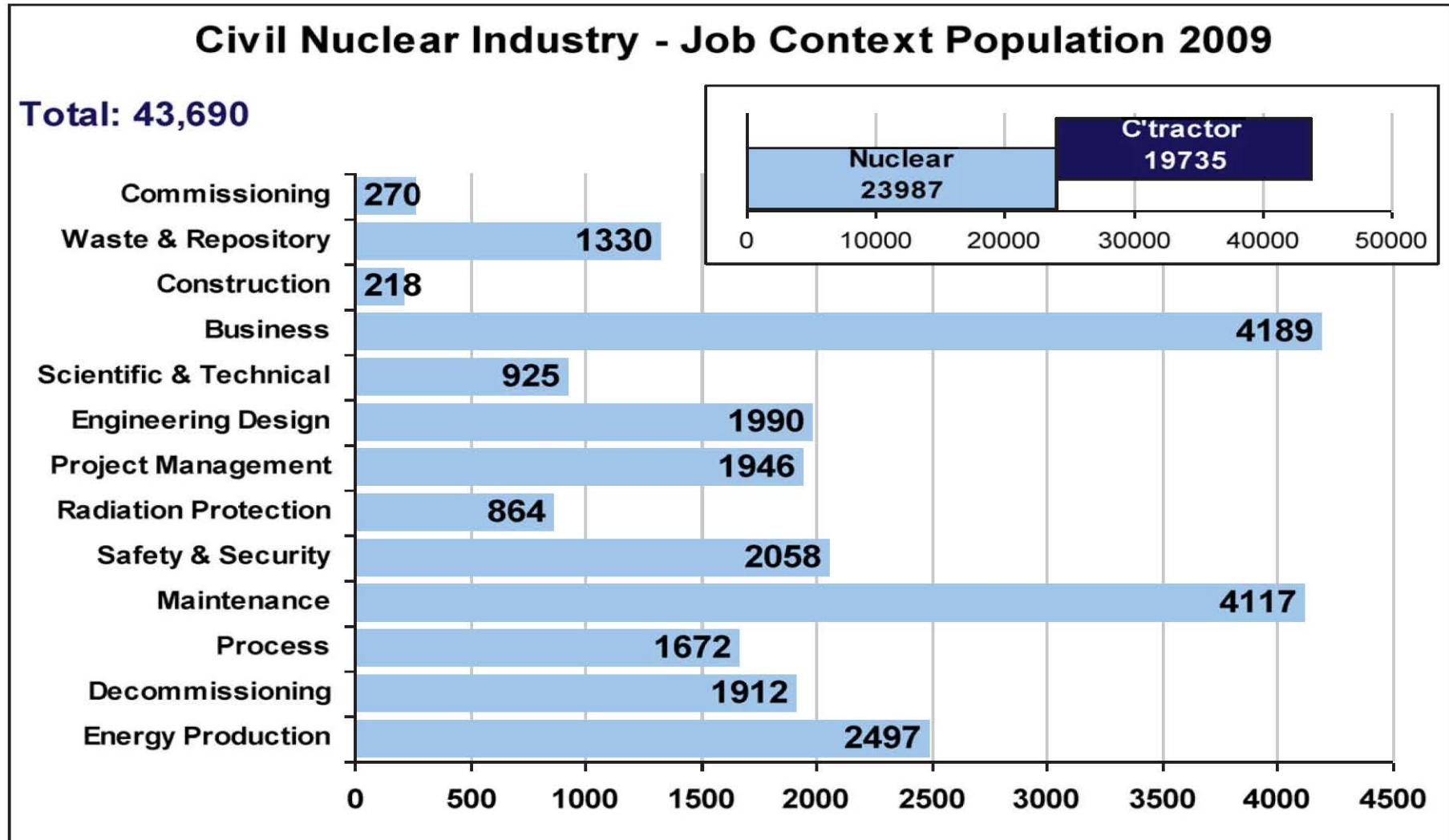
The Civil Nuclear Workforce 2009 - 2025



The Renaissance series:

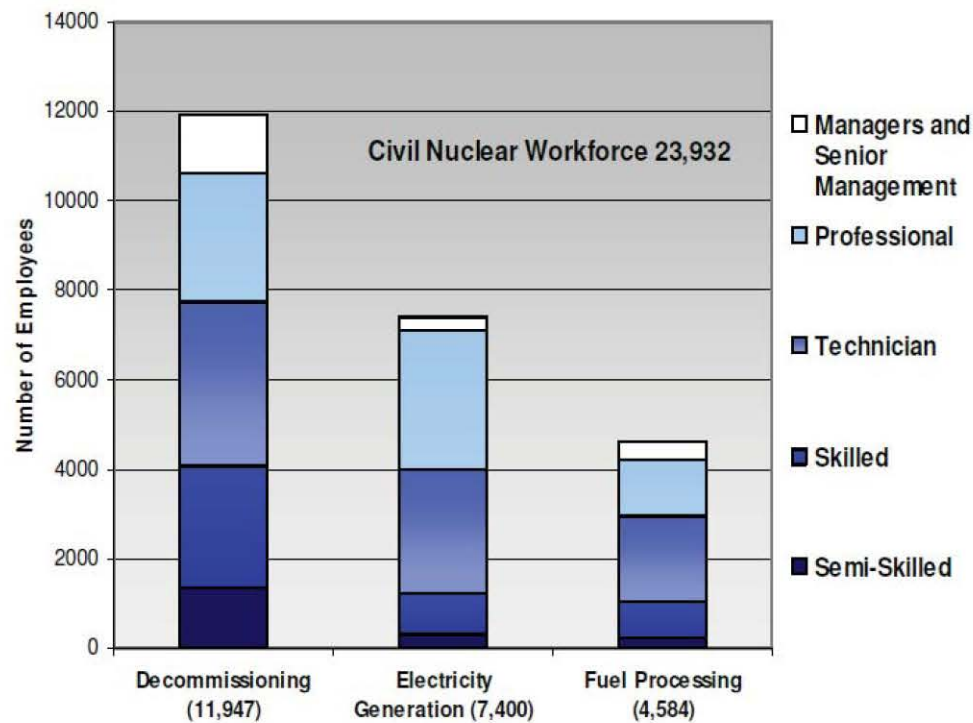
- Renaissance 1 - Power People: The Civil Nuclear Workforce*
- Renaissance 2 - Next Generation: Skills for New Build Nuclear*
- Renaissance 3 - Assurance: Skills for Nuclear Defence*
- Renaissance 4 - Illuminations: Future Skills for Nuclear*

5. Quantifying and Qualifying HR

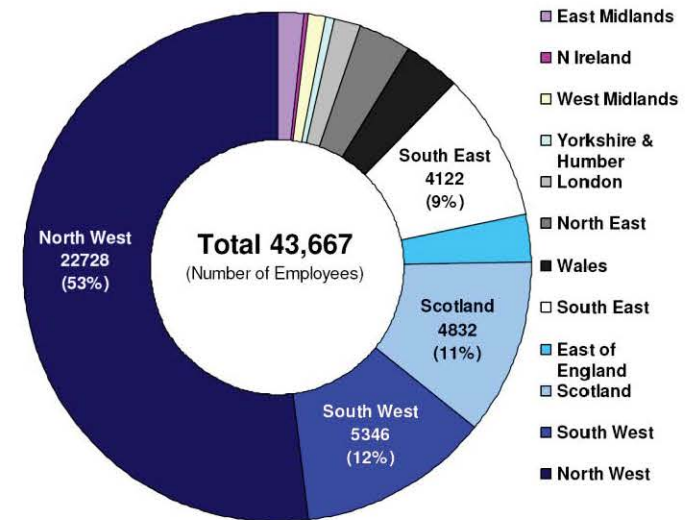


5. Quantifying and Qualifying HR

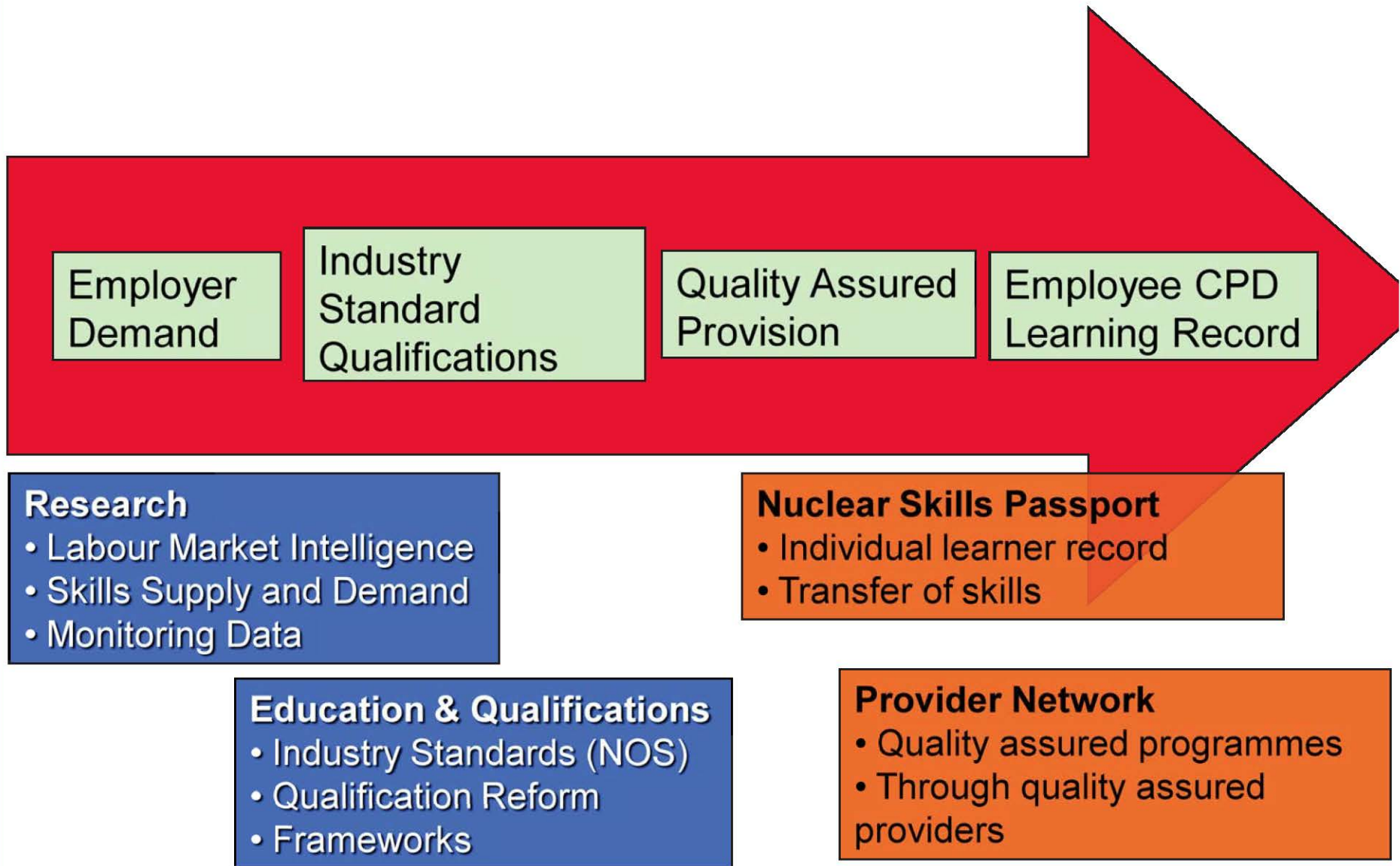
**Occupational Skill Level of Civil Nuclear Workforce 2009
(Excl. Supply Chain)**



**Civil Nuclear Workforce by Region and Nation 2009
(Incl. Supply Chain)**

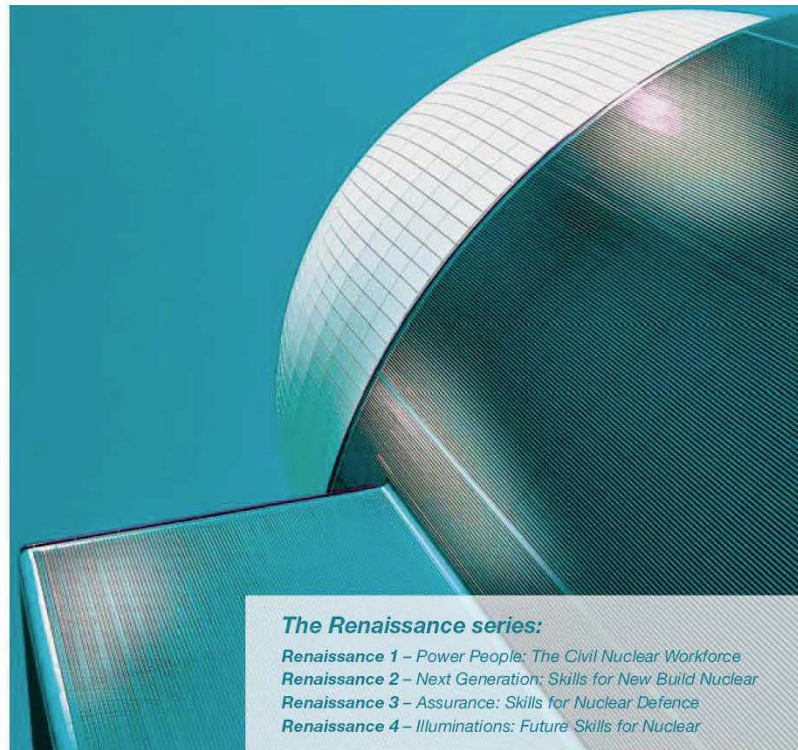


5. Workforce Development



Next Generation

Skills for New Build Nuclear



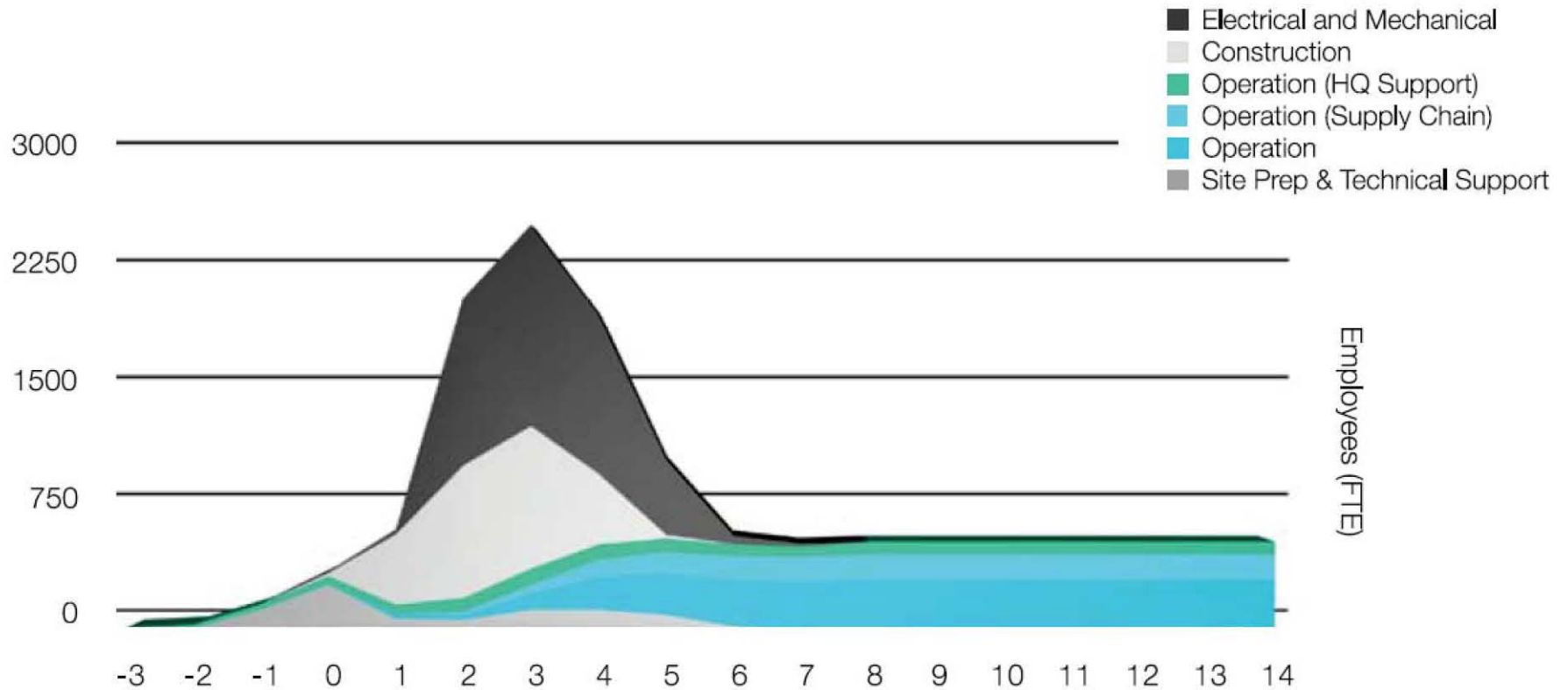
The Renaissance series:

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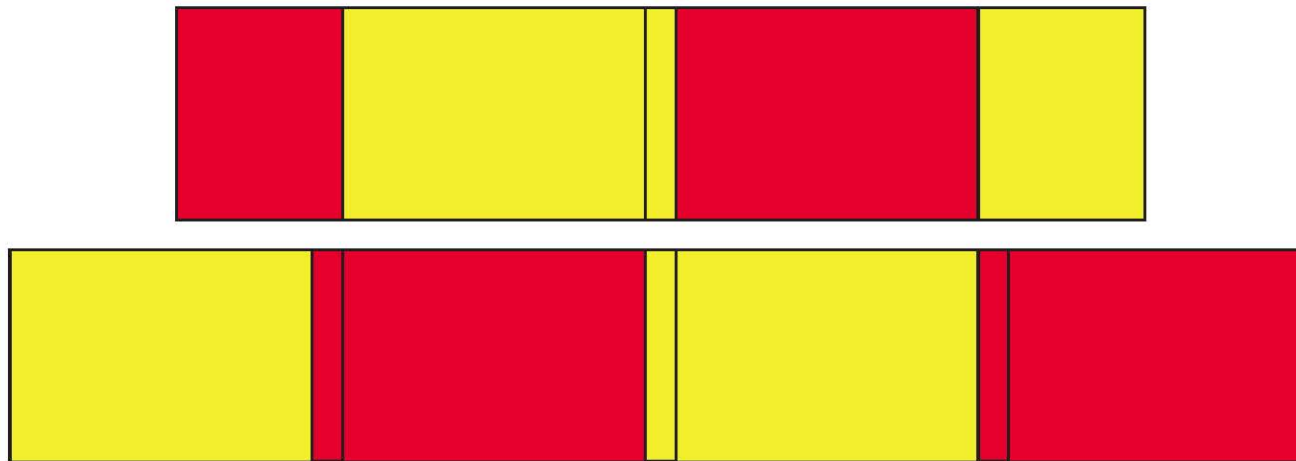
Renaissance 2 – Next Generation: Skills for New Build Nuclear

5. Projecting Future HR Demand

First PWR Workforce Level

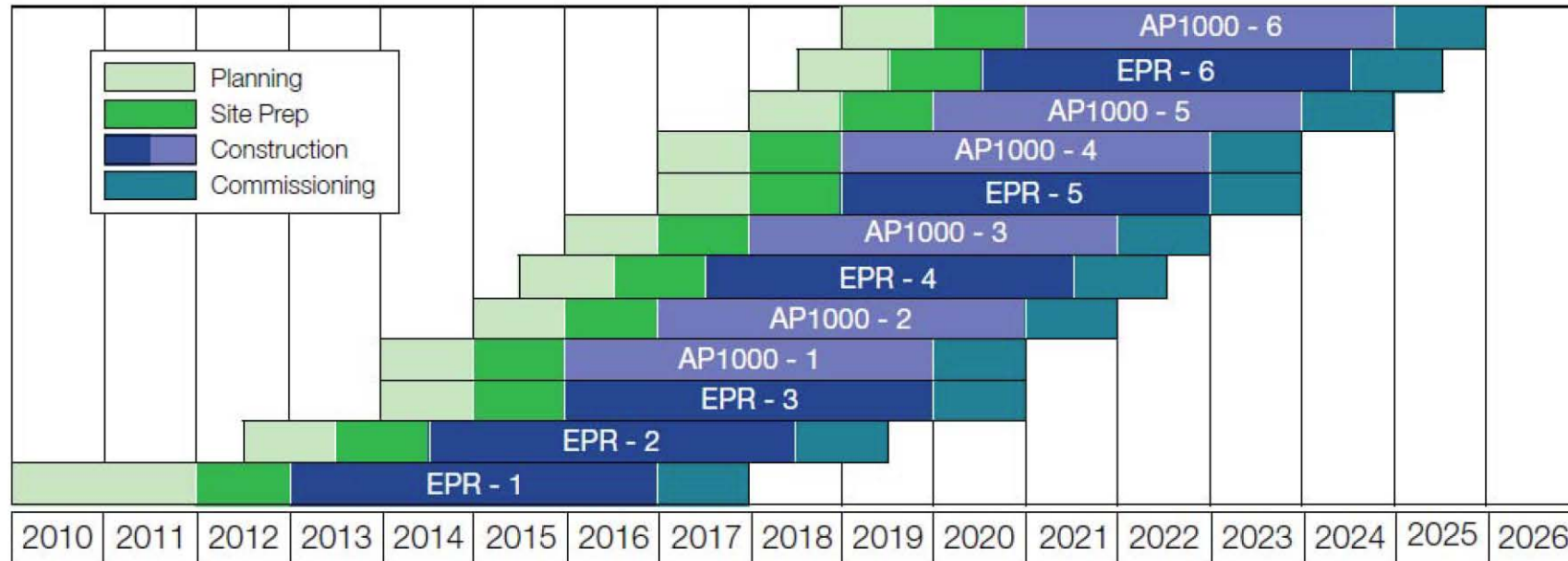


5. Projecting Future HR Demand



6. Projecting Future HR Demand

Timeline for 12 Units



16 GWe (new)	6 Twin-Unit Stations	Station (twin unit)	Construction ^a (twin unit)	Manufacture (twin unit)	Operation (twin unit)
Person years	110,000 - 140,000	21,200	13,000 60%	3,200 15%	5,000 ^b 25%

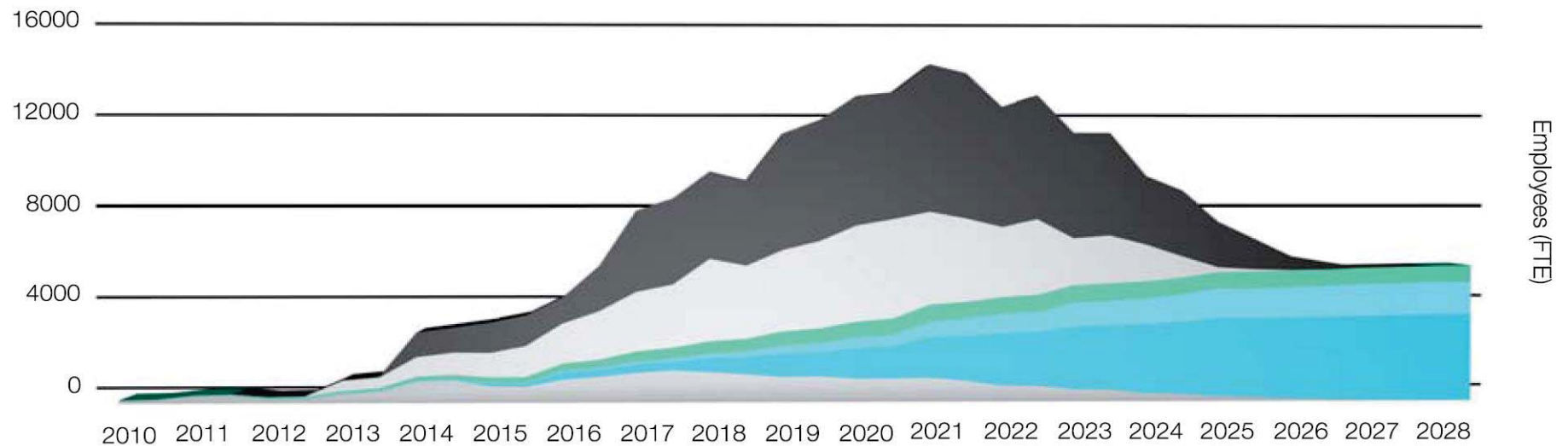
6. Projecting Future HR Demand

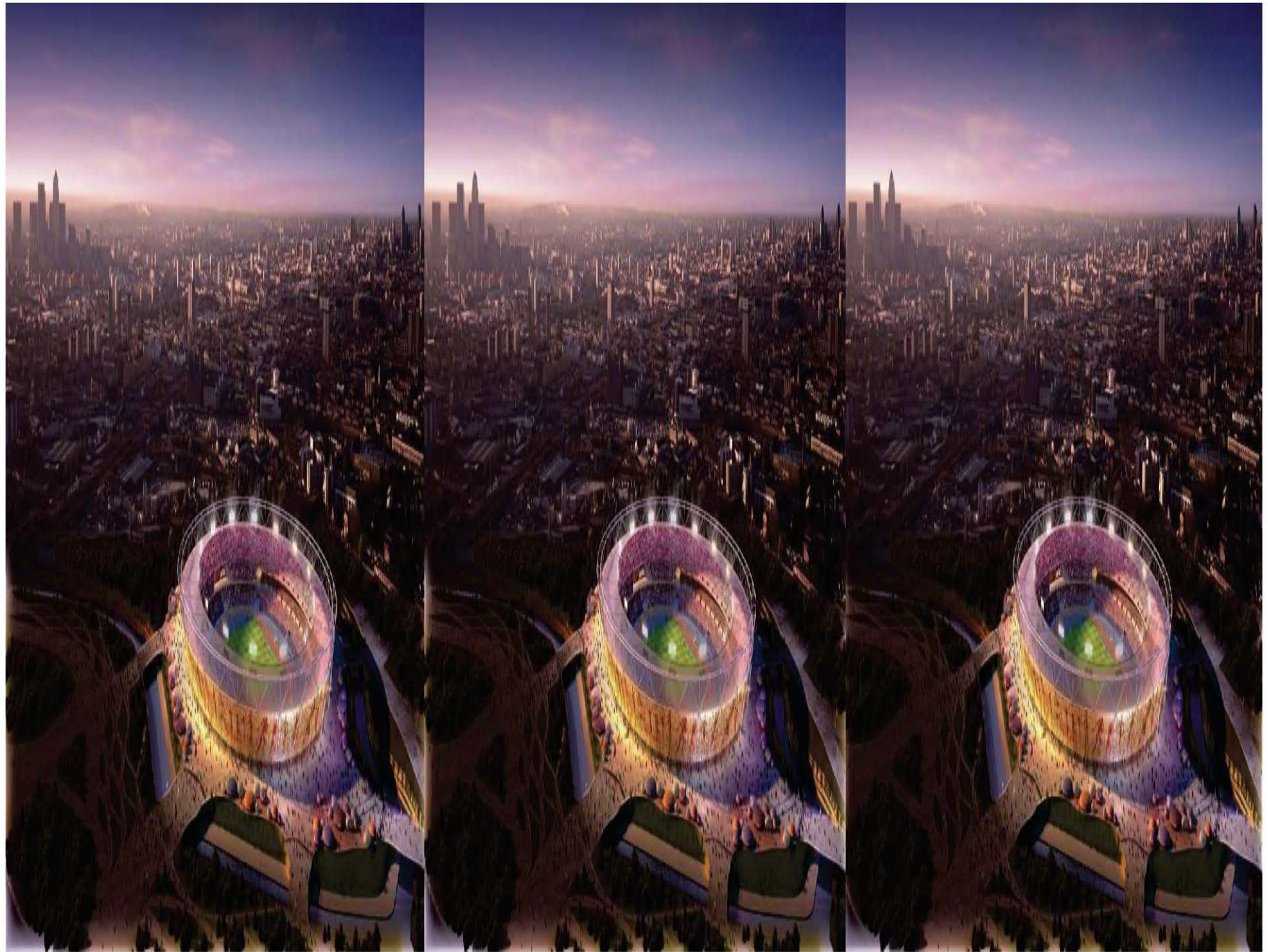


Indicative 16 GWe New Build Scenario

Integrated Workforce (6 twin-unit Stations)

- Construction
- Operation (HQ Support)
- Operation (Supply Chain)
- Operation
- Site Prep & Technical Support





6. Projecting Future HR Demand

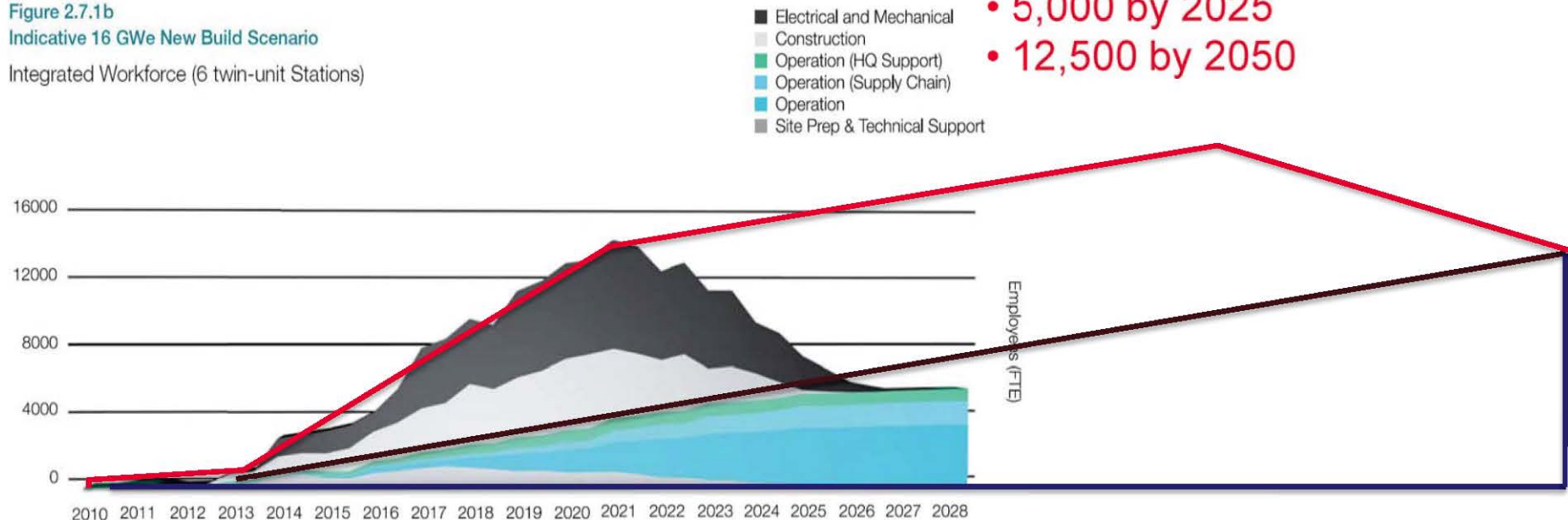


- Supply Chain - regeneration
 - 300,000 person years to 2050 (40 GW)
 - 10,000 person years peak in SC

• Electricity Generation - expansion

- 5,000 by 2025
- 12,500 by 2050

Figure 2.7.1b
 Indicative 16 GWe New Build Scenario
 Integrated Workforce (6 twin-unit Stations)



- Fuel Processing - changeable
 - 4,000 at 2010
 - sensitive to technology and policy

- Decommissioning - stable
 - 12,000 peak by 2020

7. Strength in Numbers – International Co-operation & Development



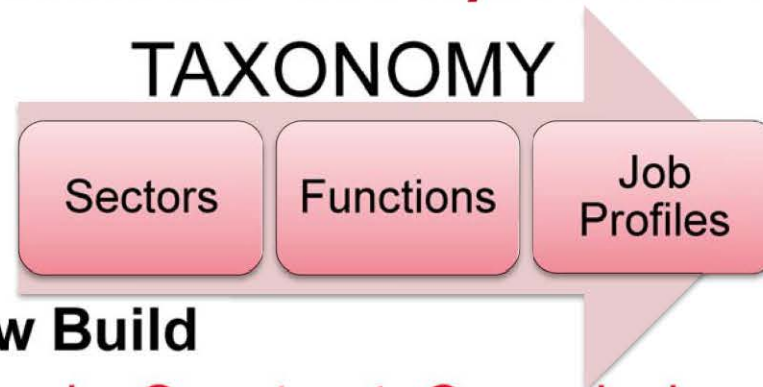


Nuclear Education and Training: From Concern to Capability



NUCLEAR ENERGY AGENCY

7. International Cooperation



- **NPP – New Build**
Design, Supply, Construct, Commission
- **NPP – Operation**
Operation, Maintenance, Waste Mgmt, Safety & Environment
- **NPP – Decommissioning**
Decommissioning, Maint., Waste Mgmt., Safety & Environment,
- **Nuclear Regulation**
Authorisation, Inspection & Enforcement, Regulation & Guidance
- **Nuclear Research Reactors**
Design & Engineering, Utilisation, Operation & Control,
Assessment & Review

7. International Cooperation – JOB ROLES

ector (P) | Plant Manager (P) | Operations Manager (P) | Shift Charge Engineer
Chemistry Manager (P) | Chemistry Technician (T) | **Nuclear Power Plant Oper**
Instrumentation Maintenance Engineer (P) | Mechanical Maintenance Technicia
Power Plant Operations – WASTE MANAGEMENT | Plant Waste Engineer (P) |
Environmental Support (P) | Radiation Protection Supervisor (T) | Radiation Me
System Designer (P) | Reactor Core Engineer (P) | Design Engineer (P)/ Civil/ (C
r (P) | Site Layout Designer (P) | Project Manager (P) | Planner (T) | **Nuclear**
Procurement (T) | Progress Control Technician (T) | **Nuclear Power Plant Build**
Engineering Construction Supervisor (T) | Engineering Construction Technici
| **Nuclear Power Plant – COMMISSION** | Commissioning Engineer (P) | Nucle
(T) | Plant Maintenance Fitter Electrical (T) |
OPERATIONS | Site Manager (P) | Site Engineer (P) | Supervisor/Team Le
MAINTENANCE | Senior Engineer (P) | Project Engineer (P) | Team Leader (T) | Tec
Leader | Support Service Engineer | Operative (C) | **Nuclear Power Plant Deco**
r (T) | Radiation Protection Monitor/Surveyor (C) | Safety Case Lead Author (P)/ Officer (

7. International Cooperation

Standard Job Profiles



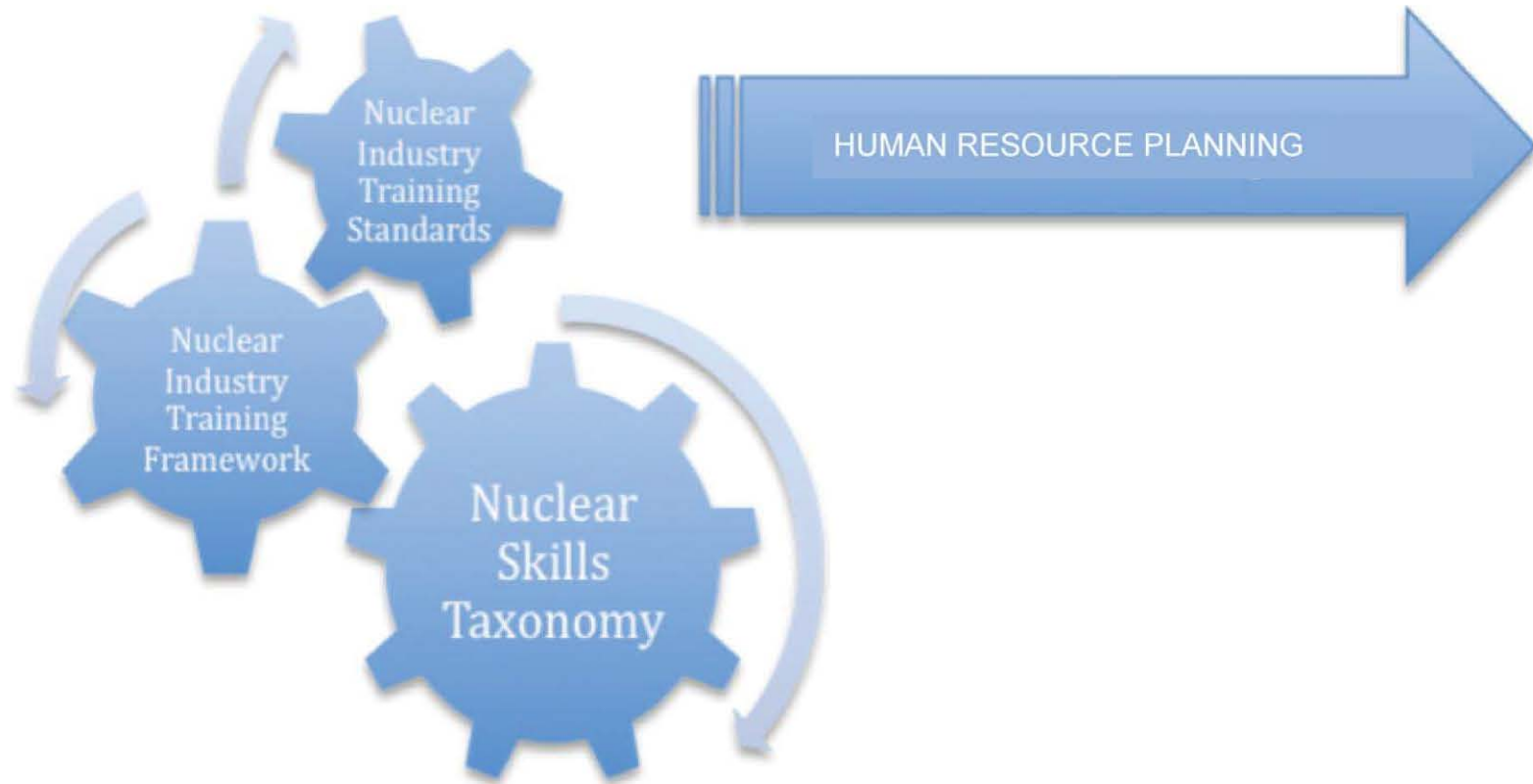
7. International Cooperation

Standard Job Specifications



Level– Professional	
Control Room Supervisor	Sector NPP – Operation (lead: Spain)
	Function – Safety
	Entry level Qualification- Three-year Degree in Engineering or related Science with suitable experience as Reactor Operator.
Job Descriptor	Training/ CPD
Direct operating personnel in all situations that occur to ensure health and safety of the public, as well as protection of plant personnel and equipment. Responsible on a shift basis for safe and efficient plant operation including start-up, shutdown, power changes, emergency and accident conditions, and special configurations as may be required for maintenance or surveillance, etc.	<p>It is assumed that the Control Room Supervisor holds Unit Desk Operator License and has passed the associated Training Programmes before taking up his role, as follows:</p> <p>Technical Competence</p> <ul style="list-style-type: none"> Plant procedures and bases. Operating Experience. Advanced fundamentals in technical areas; System description and Reactor operator theory. Reactor Thermal-hydraulics. Technical Specifications. <p>Business Improvement</p> <ul style="list-style-type: none"> Error Prevention Techniques and Human Performance Tools.
	<p>Compliance</p> <ul style="list-style-type: none"> Advanced Transient and Accident Analysis. Probabilistic Safety Assessment. Simulator Training: Normal Integrated Plant Operations; Emergency procedures; Plant Transient and Emergency Response. Emergency Plan. Radiological Protection. Safety Analysis Report. Accident Management. <p>Functional and Behavioural Skills</p> <ul style="list-style-type: none"> Supervisory Skills.
Specific Competences - Technical, Compliance, Business Improvement, Functional and Behavioural Skills	
<p>The <i>Control Room Supervisor</i> will be able to:</p> <ul style="list-style-type: none"> Direct personnel who perform activities on safety related and non-safety related equipment. Ensure that all shift operation activities associated with power generation are performed in accordance with plant procedures, technical specifications and in accordance with the requirements of the regulator. Monitor plant conditions and indications closely. Control precisely plant evolutions. Use procedures effectively in the control of work activities and equipment status and to recognize and mitigate transients and accidents. Show conservative approach to plant operations every time. 	<p>The <i>Control Room Supervisor</i> will understand:</p> <ul style="list-style-type: none"> The concepts, philosophy, and Control Room Supervisor responsibilities with respect to reactivity management and reactor core safety. Probabilistic safety assessment concepts and the importance of key equipment to accident mitigation. Fundamental and technical areas, plant design, theory and system interrelationships. Transient and accident analyses to determine that procedural actions are effective in maintaining the plant within nuclear safety boundaries during transient and accident conditions. The use of Error Prevention Techniques and Human Performance Tools. Supervisory skills to provide effective leadership to a control room shift team to promote teamwork, motivation and positive attitude. How to make conservative decisions, with protection of the health and safety of plant personnel and the public being of highest priority.

8. Stepping Up – A Qualified and Competent Workforce



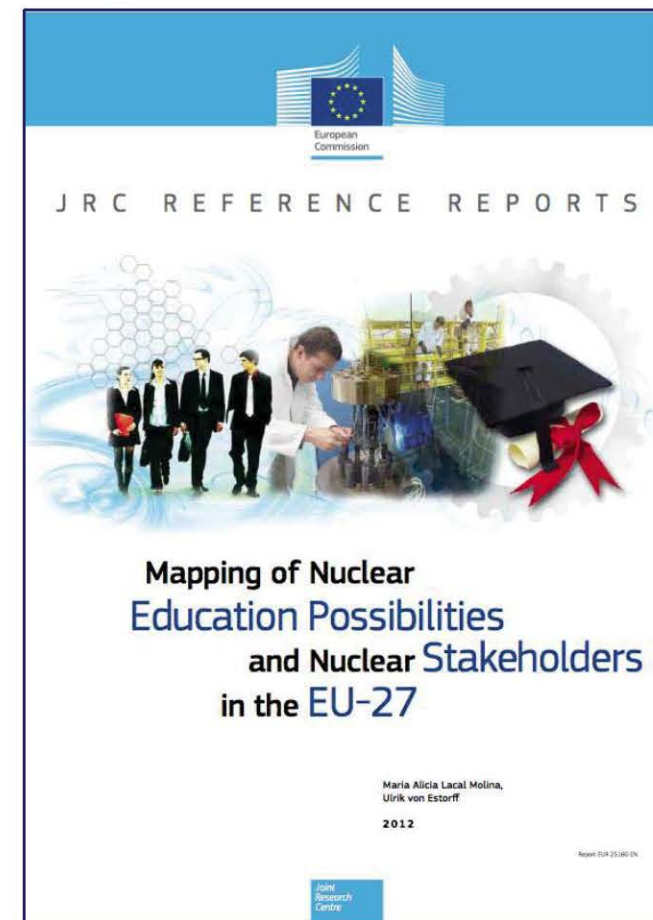
8. Stepping Up – A Qualified and Competent Workforce



A Taxonomy that captures the extent of nuclearisation of an occupation can be a powerful tool in:

- development and harmonisation of vocational training standards and qualifications
- workforce mobility
- international labour market research, scenario planning and HR observatories
- international 'passports' for training and experience
- voluntary licences to practice and supply chain competence assurance
- the safe and secure adoption of nuclear technology by developing countries.

8. A Qualified and Competent Workforce



8. A Qualified and Competent Workforce



- Job Description
- Entry Level
- Job Roles
- Job Requirements
- Competences
 - Knowledge
 - Skills
 - Attributes

Area	Job Title	Category
NPP – D	Safety Case Expert	Professional
	<i>Alternate job title(s), when required</i>	
Job descriptor		Entry level qualification
The <i>Safety Case Expert</i> provides expert, researched, peer-reviewed safety analyses and strategy supported by evidenced documentation to form a fit-for-purpose safety case, in compliance with statutory, regulatory and technical requirements of the system being decommissioned, including health, safety, environmental, ethical and social considerations.		ISCED 6-7
Roles / Functions		
<ul style="list-style-type: none"> • compliance assurance • legal/technical information management • safety case preparation, consultation, authoring, peer review and verification • safety case project management • standard setting for safety case processes and methodologies • quality assurance of safety case implementation • expert advice, guidance and recommendations • reports to..... 		
JOB REQUIREMENTS		
KNOWLEDGE (Cognitive competence)		EQF level (1-8)
• safety case standards and methodologies, including probabilistic evaluation		6
• advanced procedures for risk assessment and management		7
• engineering design and operation (of the plant/equipment being assessed)		7
• ALARA principles, as appropriate to the role		7-8
• requirements for 'due process' in nuclear safety case production		6
• principles of radiological science and radiological protection		5
• statutory, regulatory and ethical requirements for nuclear safety		6
• safety management systems such as Permit to Work, Standard Operating & Maintenance Procedures and Risk Assessment.		6
• standard procedures for dealing with radioactive sources, discharges, waste, environmental control and emergencies		3
• safety, security and behavioural expectations of those working on a nuclear site		3
SKILLS (Technical competence, abilities)		EQF level (1-8)
• review legislative, regulatory and technical literature		7
• identify, quantify and critically assess safety hazards		7
• author technical, evidence-based and compliant cases to minimise risks on safety, health and environmental matters		7
• project manage production approval implementation review and evaluation of safety case		-

9. Final Steps - HR Planning, Mobility and Knowledge Management

- Job Description
- Competences
 - Knowledge
 - Skills
 - Attributes
- Learning Outcomes
- Certification
- Accreditation
- Qualification
- CPD & VET Frameworks
- Labour Market Mobility



9. Conclusions – Characteristics of a Healthy Nuclear Labour Market

1. Policy – stability beyond economic cycle HR and support for the supply of technical skills
2. Labour market research – robust evidence base and methodology
3. Consultation – stakeholders in labour market research, education, training and research
4. Facilities – research, education and training
5. Vocational education & training – frameworks, accreditation of employer and provider provision
6. Universities - appropriate range and flexibility of courses
7. Training – establish basic nuclear awareness training
8. Employers – community, careers, HR development
9. Internationalisation – education, training, mobility.

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Thank You

Contact

Brian P Murphy

b.p.murphy@salford.ac.uk