Simulation for Human Capacity Building

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Rationale for a Human Capacity Building Program

A skilled and competent workforce is critical:
- To the country economy and for new industry sectors.
- For economic transformation and transition.

Labour supply could come from new graduates or the existing workforce:
- Workforce re-skilling, attraction and retention are just as important as graduates from the education system.
- This requires the development of the capabilities of the education and training sector itself.
- A key role to be played by partners, local firms and institutions.

Nuclear Industry characteristics:
- Large proportion of jobs requires postgraduate qualifications.
- Very large scope of competencies.
- Specific and complex backgrounds common to all staff.
Nuclear HCB: Strategic focus at high level is mandatory

Education & Training needs reforms and adaptations:
- Establish attractive recruitment pathways.
- Domestic education system certification & accreditation.

Planning & Monitoring is key for the success:
- Scanning of the existing workforce.
- Profiling of the future needs, taking into account broader economic needs.

External support from experienced vendors to meet specific nuclear workforce needs:
- Development of educational programs through local universities (BS, MS & PhD levels) with international partners.
- Partner in developing joint training and education institutions.
- Employee Exchange programs.
France: strengths supporting your nuclear HCB program

A strong and sustainable industry:

- 58 reactors in operation
  - 1,932 reactor-years of operating experience
- N°1 nuclear share in the electricity mix
  - 75% nuclear share of electricity
  - -35% lower electricity price than av. EU-27
  - Among the lowest CO₂ intensity electricity mixes globally

Where Knowledge Management is built and maintained from R&D programs, operation knowledge and experience feedback.
Simulation for Human Capacity Building

Nuclear Industry Training system development

Basic training for newcomers:
- Factorize the most widely disseminated presentation modules.
- Increase value of trainers’ competence.

Advanced training:
- Stabilize strategic skills of companies.
- Improve understanding of processes, associated skills and behavioral attitudes (simulation).

Knowledge management:
- Standardize technical culture.
- Provide access to the right information at the right time;
  - WHO is the target?
  - WHAT does he need to know?
  - WHY does he need to know that?
Nuclear Industrial Training Characteristics

Design:
- High level of interactivity.
- Modeling of the reasoning process (e.g. decision-making aid).

Operation:
- Complexity of underlying processes and phenomena.
- Interactivity close to real life.
- Modeling of processes, equipment and phenomena.

Maintenance:
- Complex systems are hard to diagnose.
- Modeling of reasoning combined with modeling of processes, equipment and phenomena.
Three focused elements for a structured approach:

**Training Content & Technology**
- Courseware, CBT, Simulators, LMS Database.

**Training & System Support**
- Content follow up, Record keeping, Reporting, Operation support, Train the trainer.

**Training Delivery**
- Teaching, Tutoring, Evaluation.

Management
Comprehensive Training system to capture the valuable knowledge of nuclear staff

- Trainee database
- Course database (Flowcharts)
- Scenario database

Learning Management System
- Assigned course & course progress
- Course result (score & progress)

Course Management
- Simulator Session
- CBT module (local or remote)
- Classroom module

Know-How
Know-Why
Training Centre

Auditable QA-SYSTEM & PERFORMANCE STANDARD
Training materials are the backbone of an efficient training program

Initial Training for New Comers
- Written material
- Audio-visual media
- Models & Mock-up
- E-learning tools

Advanced Training
- Simulators
  - Basic principle
  - Engineering support
  - Full-Scope
  - Maintenance guides
Training is essential to put in practice the knowledge.

Theoretical course, and on-the-job training are not sufficient with regards to the high level of knowledge to be embed in trainee’s minds.

Events caused by weaknesses in the use of operator fundamental continue to occur too frequently (2013 INPO Event Report IER I1-11-3).

Advanced Training organization now recognized that the training of fundamentals must include the use of hands-on experience gained on simulators dedicated for Initial Training.
Unrivalled CORYS’ capabilities in Nuclear Simulation

- Most experienced
- Worldwide presence
- Lowest risks
- Strongest Engineering staff
Tailored suite allowing students being involved and learn from experience

INTENDED TO
- Plant operators, maintenance staff.
- System designers and engineers.

A suite of complementary tools, including training materials and exercises.

A WEALTH OF ADVANTAGES
- Visualizing, testing, and observing the physics of the reactor in real time, based on validated transients.
- High, sustained levels of attention.
- Design black boxes unlocked.
- Individual work, group viewings and e-learning.
- Regular practice to maintain the right reflexes.
Overall needs:

- Validate the EPR operation.
- Train the operators.

Simulator applications:

- Operator training and licensing prior to the plant fuel loading.
- Support the validation of the plant operation (Strategies and Procedure) in normal, incidental and accidental transient.
- Support the tuning of EPR plant systems I&C functional design.
- Human Factor Engineering (HFE).
- Support the development of Plant Testing procedure.
- Contribution to the Design Engineers training.
The highest quality for Virtual reality training environment

3D gaming engine technology

Artificial intelligence algorithms for the modelling of human behaviour

Oculus with 120 Hz frequency

Wraparound screen based systems with edge blending
CORYS experience in efficient 3D environment development

- Mobile laser scanning on vehicles or aerial drones

360° laser scan

Point Cloud
- Extract tracks, land marks, object height, signals, objects, textures etc.

Simulator CGI
- Accurate GPS positioning of land marks, signals, objects with photo realistic textures.
Experience feedback

Average time of sustained attention of the trainee:
→ 4 to 5 min.

- Importance of training design.
- Attractive and stimulating interfaces.

It's easy to fall into the "play" trap:
- Beware the gadgets!!
- The rights and obligations of the trainee.

Importance of the assessment control:
- Responsibility of trainees and trainers.
- Skills management and career progress.

ROI difficult to estimate:
- Long terms benefits and intangibles should be understood.
Take aways

Beware of the « Free » tools concept:
- What has no price has no value…
- Beside the tools, an efficient training organization needs to be set up which will requires more investment than the tools themselves.
- Nuclear electricity production is capital intensive.

Partnerships are efficient to disseminate nuclear knowledge:
- Many simulations companies originated from partnership or Research Institute spin-off.
- Most experienced nuclear countries set up « Human Capacity Building » capabilities for New Comer countries (once again, it is mostly private initiative).

Training shall be part of an overall Country HCB initiative.
Worldwide footprint

Armenia
Metsamor
State Engineering University

Australia
Royal Australian Navy

Belgium
Electrabel (Tihange, Doel 1&2, Doel 3&4)
SCK-CEN
GDF SUEZ

Brazil
CTMSP

Bulgaria
Kozloduy NPP

China
CGNPC (Ling Ao II)
TNPJVC (Taishan)
State Universities (SWU, NUAA, NJIT, HIT, NEDU, BUAA, SDJU, IFCE)

Czech Republic
CEZ (Dukovany)
ORTEP

France
AREVA
CEA
DCNS
EDF
EDF CIPN
EDF CNEN
EDF SEPTEN
EDF UFPI
GDF SUEZ

Greece
PPC (Agios, Dimitrios)

India
BHEL
IIT Roorkee (AHEC)

Lithuania
IGNALINA NPP

Kazakhstan
TENGIZ Chevroil

Russia
Beloyarsk
Kola
Novovoronezh

Slovakia
Slovenske Electrarni (Bohunice V2, Mochove)
VUJE

Slovenia
KRSKO NPP

Sudan
EDF

Switzerland
KKL

Ukraine
Rovno NPP

United Kingdom
EDF Energy

United States
Constellation
Dominion
Duke Energy
Energy North-West
Entergy
Exelon
First Energy Nuclear
Floria Power & Light
Nebraska Public Power
Northern States Power
NRC
Progress Energy
PSEG
South Carolina Electric
Southern Nuclear
TVA

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