Building proliferation resistance

Joint Esarda/INMM workshop
Future Directions for Nuclear Safeguards and Verification

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Nuclear non proliferation and security culture
within EDF nuclear fleet

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Sustainable Nuclear Production in France

Nuclear production: Safety as main priority

→ 58 PWRs (63 GW); 3 standardized series
   900 MW (34 units), 1300 MW (20 units),
   1500 MW (4 units)

→ 413 TWh (average 2006-2009)
   ≈ 77% of electricity generation in France

→ a low carbon energy mix:
   nuclear 4 g CO2/kwh, average EU: 400 g/kwh

→ launching of the new EPR reactor at
   Flamanville 3;
   public debate launched for a new EPR at Penly 3

EDF share in nuclear production in Europe: UK:
including BE: 8.7 GW nuclear, 54 TWh (2009)

Nuclear generation: 408 TWh in 2010

Main recent technical issues:
- SG cleaning and replacement program,
- generators stators, main transformers
EDF strategy for sustainable nuclear generation
Key Progress and Challenges

Remain an industry standard worldwide
- Nuclear safety and safety culture as a first priority at all levels
- Experience feedback and efficiency of defense in depth, emergency preparedness, post FKH feedback
- Competitiveness, availability and operational performances

Plant Long Term Operation management: goal up to 60 years
- Continuous improvement policy
- Periodical 10 years Safety Reassessment Process

Fuel cycle efficiency, reprocessing / recycling and HLW waste management
- A major asset for sustainable nuclear energy

Succeed in the EPR Flamanville-3 and EPR Penly-3 construction project
- Public debate and acceptance
- Safety, quality, schedule, cost, etc.

Become a major actor in the international renaissance of the nuclear industry
- International cooperation
- New Nuclear Build projects: China, UK, USA, Poland, RSA, Netherlands …

Developing the skills and competences needed to achieve these objectives
- International Master in Nuclear Energy
**Perspective for the future:**
- participation to GEN 4 advanced fast reactors programs, timeframe 2040 / 2080 …

**Major conditions for nuclear development and acceptability:**

- Safety as a top priority,
- transparency and social acceptance
- waste management and environment, appropriate policy framework
- security of supply, long term resource sustainability, economy and competitiveness
- non proliferation, security, safeguards and international institutions
Nuclear fuel cycle industry in France
A major contribution to energy sustainability

Uranium and conversion
≈ 8000 t/year

→ time period
20 years

Enrichment
≈ 5.5 MUTS/year

UO2 Fuel fabrication ≈ 1000 t/year
2000 assemblies/yr (45 GWd/t average, max 52 GWd/t)

Recycling: MOX fuel
120 t/year on 22 units 900 MW (30% core) --> 43 TWh/yr

MELOX Fuel Fabrication plant

10 t /yr Separated plutonium (1%)

Reprocessed uranium: ~ 1000 t/yr (U235 content 0.8%)
600t re-enriched and recycled on 4 units 900W (100% core)
80t REPU fuel/yr --> 28 TWh/yr

Spent Fuel:
1200 tons /year (UOX et MOX)

Spent Fuel Transportation to La Hague, interim storage in cooling pools
1200 tons/year

Reprocessing:
1050 t / year

La Hague

430 TWh/yr

58 EDF NPPs
22 units loaded with MOX
4 with REPU fuel

Vitrified High level Waste
Interim passive storage
Disposal optimisation

around 150 m³/yr vitrified HLW
around 200 m³/yr compacted ILW
Depending on Burn up

Nuclear non proliferation and security culture at EDF - ESARDA/INMM workshop - October 2011
A proliferation resistant fuel cycle

- The proliferation risk may come mainly from two specific activities: enrichment of uranium and reprocessing of spent fuel
  => Those activities are performed in France under international safeguards, within protected and secured facilities

- The closed fuel cycle is feasible, economic, and reasonable industrial solutions have been implemented to address the non proliferation issue

- The residual plutonium is concentrated in MOX spent fuel:
  => stored in cooling pools, under international safeguards
  => for possible reuse to start GEN4 fast reactors in the far future,

- The vitrified high level waste canisters do no more contain plutonium:
  => safeguards terminated

- Transportation in secured and robust casks,
  => under strict surveillance and protection rules (Infcirc 225 rev 5)
International and regional controls
A strict regulatory framework

- Euratom treaty (1957) and controls by EU inspectors

- application of the Non Proliferation Treaty

- application of Voluntary Offer Agreement (IAEA INFCIRC/290)

- application of IAEA security recommendations
  (ex INFCIRC 225 on Physical protection of nuclear material and nuclear facilities)

- Nuclear Suppliers Group (NSG - 1978): implementation of guidelines for nuclear exports

- Implementation of the IAEA Additional Protocol
  . R&D activities, export/import activities …
  . increased right for the IAEA (complementary access…)

- UN Security council resolution 1540 (28/4/2004)
  on the prevention of proliferation (non state actors…)
- Application of the "Code of Defence", in compliance with international regulation: Art. L. 1333 and further

- Control by the Defense and Security high civil servant (HFDS) at the ministry level, with dedicated national inspectors IRSN as technical support (Nuclear Defense expertise department),

- Application for all nuclear material and facilities in France (plutonium, uranium, thorium, + lithium 6, deuterium, tritium) To comply with control requirements and international agreements to prevent loss, theft or diversion of nuclear material

- Protection and custody of nuclear material within controled facilities, under the responsibility of dedicated and authorized personnel

- An authorization regime for holding, transport and use of nuclear material delivered by the HFDS for each facility
National control of nuclear material in France

- **A responsibility for each nuclear operator:**
  - internal expertise and organisational responsibilities
  - a specific authorisation for sensitive material holding,
  - duly authorized officers,
  - full knowledge of the position of any object containing nuclear material
  - material accountancy along the whole nuclear fuel cycle,
    including fresh fuel, spent fuel and nuclear material fissile and fertile, under QA
  - monitoring and detection of any anomaly
  - periodical report and inventory to national authority
  - implementation of protection devices for sensitive material
  - internal controls and audits

- **Acknowledgement of responsibility:**
  - the holder of fissile material, in charge of the custody of fissile material
  - dedicated and authorized staff
Designation of authorized responsibilities
- the Director of each nuclear plant
- the responsible in charge of nuclear material
- the personnel in charge of material accountancy

A system of nuclear material accountancy for any movement or transformation,
- declaration to national accountability system (IRSN)
- inter-comparison and control between local and national system

A system of monitoring and follow up of nuclear material
- to know at any time the location of any object or item containing nuclear material in the facility

Support by a dedicated team of experts at corporate level
- at the operation department of the nuclear fuel division
- interface with National Control, methodology….
Internal controls
- Annual physical inventory and verification of accountability system
- control and record by plant management
- internal audits of nuclear material accountability

External controls
Inspections by HFDS inspectors (IRSN), planned or fortuitous
- organisation
- technical domains (receipt, sending, inventory …)
To check compliance with the authorization file and AQ rules

Euratom controls with equivalent requirements
- an authorization regime
- a system of nuclear material accountability and monitoring, with monthly declarations
- Euratom inspectors: control of physical inventory
Four key points for non-proliferation, as seen from a nuclear utility perspective

1- As an operator, implement government policies on institutional guarantees (treaties, safeguards, IAEA “3S” safety, security, safeguards)

2- Apply safeguards at the technical level, through material accountancy and additional measures through the application of the IAEA additional protocol at each stage of nuclear material management

3- Support proposals by international organizations involved in the fuel cycle industry (fuel bank…), provided they respect market conditions.

4- Prepare for future fuel cycle, including resistance to proliferation, while avoiding increased complexity
Security of "vital importance activities" in France

Application of the February 23, 2006 governmental Order about the security of "vital importance activities"

- « Domains of vital importance" and "operators of vital importance" are defined by governmental order

- At national level elaboration of "national security rules", based on risk analysis and threat scenarios, applicable to a domain of vital importance

- Elaboration of a "security plan" by the "operator of vital importance", in compliance with the national security rule for the domain; it includes a list of "facilities of vital importance", of which unavailability could impact economic, security or vital public interests for the country

- Designation of a responsible in charge of security within the "operator of vital importance"

- For each "facility of vital importance", a "specific security plan" is elaborated, in compliance with the "security plan"; it is submitted to the responsible prefect at the geographical department level
Recent orders regarding security of nuclear material

Physical protection and control of nuclear material, facilities and transport  
(17/9/09 decree – jo 18/9/09)

Physical protection and control of nuclear material during transport  
(18/8/10 ministerial decree - jo 3/9/10)

Implementation of physical control and accounting of nuclear material  
(9/6/11 ministerial decree - jo 7/7/11)

Physical protection of facilities containing nuclear material  
(10/6/11 ministerial decree – jo 6/7/11)

Details for the study related to protection of nuclear material and related facilities  
(3/8/11 ministerial decree – jo 1/9/11)

Details for the authorization request to detain nuclear material  
(5/8/11 ministerial decree – jo 26/8/11)
Protection of industrial assets (human, material, knowledge…) against malevolent action has always been taken into account.

An evolving context:

- new technologies, new threats …

- human, financial, material aspects…

Goal:

- Protection of human, material and knowledge assets

- to preserve operational capacity, competitiveness and public confidence

- within national regulatory framework
Principles

- Security involves each employee, which must be aware of his responsibilities and role;
  => not only a technical issue but a dedicated culture:
  => questioning attitude, rigour, vigilance…

- Security is based on risk analysis, while preserving cost effectiveness:
  => security measures are in proportion with potential consequences,

- Security is integrated in operational processes and tools
  => a constraint in the organisation, while preserving efficiency

- Security measures comply with existing regulations,
  => while preserving the rights of employees, individual freedom and privacy
EDF security culture policy: principles, organisation, rules

Organisation

- The Security Director and the Security Department at corporate level:
  . general organisation and policies in the different domains related to security,
  . relationships with external authorities,
  . coordination with representatives of operational divisions

- The Security Mission at the Nuclear Production Division level

- A Security Council for Industrial Production (CSIP), to define the orientations
  . related to operation and engineering division activities (including information system..)

- A clear definition of operational responsibilities:
  . management of each operational unit
  . integration in the operational quality system

- Treatment of events to enable progress:
  . detection, analysis, lessons to be drawn and experience feedback

- Internal control, to maintain a continuous improvement
  . reporting, internal control process and audits
The rules

- Security of employees against assaults

- Security of informations, according to their sensibility level

- Security of the information system and telecom system

- Information of employees

- Taking into account external intervenors or suppliers

- Security of business premises

- Security of staff and projects abroad

- Security of industrial facilities and grids =>
Security of industrial facilities and grids

- Risk of malevolent action with potential consequences on plant production, environment, public health and safety…

- Application of regulatory requirements for the "Security of Vital Importance Activities"

- Using defense in depth principles (prevention, surveillance, action…)

- Security measures are defined in a consistent way with nuclear safety measures, while taking into account the prevention means by public authority

- Risk analysis are periodically reassessed

- Informations regarding security are protected as necessary, while preserving transparency

- Exercises and drills related to security are periodically organised to draw experience feedback using conceivable scenarios and involving public authority,
Thank you

for your attention