EDF R&D

Systemic approach to Safety: Human and Organisational Factors Research Areas
EDF R&D: KEY FIGURES

2100 people

- 370 doctors
- 150 doctoral students
- 200 research fellows from Universities and other higher education establishments

€ 520 M

2011 budget

15 Departments

Industrial Risk Management Department

- Probabilistic Safety Analysis
- Systems Risks Analysis
- Human & Organisational Factors
- Modelling & Simulation of Processes

7 Research centers
- 3 in France
- 1 in Germany
- 1 in the UK
- 1 in Poland
- 1 in China

500 Major research projects per year
Human Factor Expertise at EDF (France)

- 58 reactors, 1 under construction (EPR)

- A distributed network of Human Factor experts
  - A Human Factor team at Nuclear Generation Division
  - 1 or 2 HF correspondant by NPP
  - 4 HF experts at Engineering Divisions
  - A HOF team of 20 researchers at R&D Division
R&D Human & Organisational Factor Team

Skills and ressources

R&D HOF research dates back to early 1980's
- post TMI : beginning of the Human Factor Team : HRA & ergonomic design for the N4
- post Tchernobyl : Safety Culture and Safety Management
- 2000 : Organisational Factors

Facilities
- Easy access to EDF's french NPPs and dams => empirical data from field studies
- Easy acces to full-scpe training simulators

Human Ressources Today
- 20 social science researchers & experts, 3 PhD students
- Multidisciplinary backgrounds :
  - French -tradition Ergonomics & Cognitive Psychology,
  - Sociology & Political sciences,
  - HRA Engineers
In close contact with EDF’s operational units needs

3 strategic phases in the plant’s life cycle where HOF are integrated

- 1. During the installation design phases or redesign
- 2. During operating or maintenance stages
- 3. Incidental and accidental situations assessment

- Diagnosis & evaluation
- Recommendations
- Methods and Guidelines
- Pronostics for decision support

→ Scientific publications
Main theoretical positions:

- A “realistic” perspective and positive approach: people are source of performance and safety.
  - No focus on human individual errors but rather on humans as reliable although fallible

- A “systemic” perspective: people are part of a whole global socio-technical system
  - Taking into account cognitive, organisational and cultural aspects in order to design work situations

- Human Factor studies based upon social sciences concepts
  - Central role of real work analysis and importance of context vs experimental laboratory methods
  - Qualitative rather than quantitative methods
Three poles of HOF expertise

- **Work place studies (simulators & on-site) for human-centred design**
  - Procedure Guidance, automation & operator’s practices for EOPs
  - Human Factor Engineering in computerised control rooms (EPR) and technical modification projects
    - Designing French EPR: organisation, roles, staffing
    - Supporting the 1300 MW decennial upgrading = MCR digitalization
  - Evaluation of the use and appropriation of Information Technology

- **Human and Organization Reliability Analysis**
  - MERMOS method: new generation HRA including organisational factors

- **Human & Organisational factors for risks management**
  - Operating experience and near misses for Safety Management
  - Assessing Human Performance tools and managerial practices around these tools
  - Accident analysis: understanding organisational failures in order to assess vulnerability & resilience of organizations faced to accidents
### Some examples of R&D studies

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<th>Issues &amp; Orientations</th>
<th>Main objectives</th>
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<tr>
<td>SOH (socio-organisational &amp; human) approach to technical &amp; organization modifications</td>
<td>- Methodological guidelines supporting managers and designers to take HOF into account in their technical design projects  &lt;br&gt;  - HOF sensibility analysis is to be done before each modification  &lt;br&gt;  - Adaptation of the approach for organisational modifications  &lt;br&gt;  - Explore the issue of engineering practices reliability and decision making</td>
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<td>Integration of H&amp;OF in the EPR Fla design</td>
<td>- Lessons learned from the N4 HF evaluation  &lt;br&gt;  - 10-year Human Factor program for the design and the definition of the process control operating means and new staffing definition as well as maintenance activities.</td>
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| **Outage Control Rooms & new outage organisations**                                  | ○ Contribution of work analysis to the design of an innovative organisation for outage management  
○ Supporting the design of innovative collaborative tools for the OCC                  |
| **Anticipating the impact of modification of a socio-technical organisation** (tagouts in USA and in France) | ○ Aims to determine whether North American work organization regarding tagouts and the its supporting computer tools could be of interest for redesigning French ones                                                                 |
|                                                                                      | ○ Improve the envisionning of future work situations by formalizing a method aiming to anticipate the consequences technical & organisational modifications in complex systems. |
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| **Post Fukushima support to Generation Division** | - Helping to define staffs and procedures for extreme situations with external  
- State of the art on stress and decision making under stress  
- Socio-organisational analysis of the impact of new crisis management organisation (the FARN) |
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| Operating experience feedback: **knowledge and methods for operating plants and for their design** | o Contribute to the quality of operating experience analyses and to a better use of operating experience  
|                                                                                       | o Stabilize and distribute the knowledge concerning the component of organisational safety.                                                      |
| Safety management & safety culture: **develop knowledge and methods to improve Safety Management** | o Benchmark of Safety Management methods, formalize the lessons learned from the R&D case-studies already realized  
|                                                                                       | o Studying managers implication in Human Performance tools  
|                                                                                       | o Define criterias to asses the evolutions of Safety Culture |
Context

Contradiction between a trend for more prescriptions & procedure compliance and the need for the crew to keep margins of autonomy

Improve the efficiency of the operating crew in accidental situations

Core Issue

Do state-based EOP’s with very detailed level of guidance support operator's understanding of the situation or could they hinder the global interpretation of the accident?

To what extent does the crew should have the global awareness in real-time of everything to handle an incidental situation?
Main findings

- State based EOP's constitutes a robust system: it handles incidents in spite of the passive role given to the operators.

- New knowledge for design, training & doctrine philosophy:
  - The gap between operator's logic and procedure's logic (operating rules, designers, and procedure writers) relates to the contextualisation of procedures.
  - Procedures, operators, and the process have different time scales => operators bridge the gap between all the time-scales.
  - EO P act as a language with a specific syntax and lexicon (sentence structure & meaning of words).
  - This research has contributed to new design principles for French EPR.
International Networks

Collaboration with the French Foundation for promoting an Industrial Security Culture (FonCSI)

Halden Reactor Project
- Contribution internationale dans les études sur la fiabilité humaine
- Partage de méthodes et d’outils entre exploitants nucléaires

European Platform on Industrial Risks (FTPIS & ETPIS)
- Contribution à la création et à l’animation sur les risques industriels, volet FOH en tant que « Focus Group Leader »
- Membre élu du « Management Board » de la plate-forme européenne

Création of "Human Reliability Analysis Society"