Ways to improve field operation on NPPs facilities by bringing additional operator aids

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Introduction:

The new EDF / R&D project INTEP
Low dissemination and use of modern IT solutions across power plants, while complexity and requirements are continuously growing

EDF Nuclear fleet:
- From now up to 2020, almost of the existing 58 plants (+ 1 or 2 EPR) still in operation.
- Target for life expectancy over 50 years

For all the fleet:
- Growing expectations and requirement: safety, environment, communication and reputation
- Continuous increasing complexity of the processes and the constraints
- Human Reliability stakes, linked to changes in workforce: ageing workforce, retirements, needs for knowledge capture and transfer, different expectation and culture of new hires « MSN generation », increasing needs for training, attractiveness of jobs,…

One of the identified ways of improvement
- More use of modern IT solutions within the plants

But
- Numerous barriers that hindered their deployment: safety requirements, standardization of the plants, size of the fleet, usability of new technologies, …
Two major projects: a new EAM and INTEP

A main enterprise project:
- EDF is redesigning its nuclear fleet technical Information system (EAM): in service in ~2011

A main R&D project
- The new INTEP project is dedicated to operation aids, based on advances IT technologies
  - Normal operation
  - Outage
  - Field operation
  - Training

Moving to distributed sharable operation information for all trades (jobs)
Smart applications to support operation and diagnosis
  • Smart co-pilot for some focused operations (b. eg. help to follow temp. gradient after refueling)
  • Shared dashboard with process monitoring KPI
  • Anticipated diagnosis from process data harvesting :search and retrieval capabilities, anticipation of failures through datamining and prediction models

Smart help for field operations :
  • Priority focused on padlocking and lining-up for outage
  • Integrated solution to invent :
    prepare > load on PDA > simplify and secure (RFID, barcodes) > visualize (control room, OCC, ..)

Wireless solution, RFID and suitable mobile terminals and local networks
  • design an optimized WiFi + network adaptation solution, EMI compliant, cost effective : best coverage with minimum extra wires
  • define standards + select/validate mobile terminals and peripherals (tablet PC, PDA, RFID tags, antennas...)

New solutions for outage management :
  • audio& video monitoring, share real time information (dashboards) , …
  • for innovatives organization solutions(outage c. center, radiation c.center, one stop shop, …)

3D solutions for outage management and maintenance/logistics preparation
  • Under deployment : Global outage preparation (packing), Detailed simulation on specific maintenance operations
  • Next priority : 3D / pictures / video bases for logistics preparation and maintenance pre-job briefing

New solutions for training
Launch time table

- Chose projects themes with EDF operation top managers
- Determine projects objectives; outputs, road maps and budgets
- Prioritize outputs and lock R&D budgets for 2008
- Launch R&D projects

- Solutions should be ready for on site demonstration after 3 years or less
- Implementation should be feasible in 5 years or less
- 58 nuclear plants: more than 12 plants a year
- At this stage, we don’t take into account the possible opportunity of a deep renovation of CC system at mid life
The EVEREST Plateform

concept of “operation lab”
The Everest Platform

Everest is a flow measurement loop
- 120 I/O
- 4 rooms (2 floors)

Total renewal of its I&C system

Open architecture
Working on Everest

Collaborative approach, including all visions

- Operator
- I&C designer
- Field operator
- Human Factor
- Manager
- Researcher
- Maintenance
Working on Everest

Methodology

To define project objectives, outputs, road maps and budgets

To prototype on Everest

Selection of the best proposals

To prototype on NPP
Smart applications to support operation and diagnosis
Smart co-pilot for some focused operations

By example: help to follow temperature gradient after refueling

• An « intelligent Co-pilot » that proposes:
  • An optimal operation strategy
  • A vision of future potential risks : i.e. risk of cold
  • The tasks to perform
  • Training just before an operation (no need of process data)
Shared dashboard with process monitoring KPI (1/2)

To improve efficiency and environmental performance for pulverised coal unit…

- Diagnosis
- Immediate action plan
- Help on line

4 stakes

- Overall optimisation of the unit performance
- A compromise between the constraints.

Environment

- Diagnosis
- Immediate action plan
- Help on line

Customer

- Stake quantification
- Analysis of end results
- Predict to anticipate and optimise under constraints
Shared dashboard with process monitoring KPI (2/2)

- Survey of NI operation set points
- Survey of CI operation set points
- Following of CI components performances
- CI overall identification of efficiency loss
Anticipated diagnosis from process data harvesting

Anticipated diagnosis from process data harvesting: search and retrieval capabilities, anticipation of failures through datamining and prediction models.

Process data recovering
(I&C, operation aids, maintenance sensors network)

diagnostic and prognostic modules

Visualization tools
4

Smart help for field operations
Début

Demande à l’AT de lancer le lignage mécanique pour mise en brassage du réservoir 011BA

CR de l’AT d’exécution du lignage mécanique pour mise en brassage du réservoir 011BA

OUVRIR 1ASG263VD

Mettre 1ASG171PO en marche

Laisser brasser le réservoir 011BA pendant 2 H, sauf avis section chimie

Demander à la section chimie une analyse du réservoir 011BA en brassage

Compte rendu, section chimie, de l’eau 011BA

MCR procedures

Field procedures

8th IEEE conference
Padlocking and lining-up for outage (2/4)

Integrated solution to invent:
prepare > load on PDA > simplify and secure (RFID, barcodes) > visualize (control room, OCC, ..)
Padlocking and lining-up for outage (3/4)

Simplify and secure: wrong configurations
Survey
(RFID, PDA, Networks, CAD)

If you turn this valve, there is a risk of wrong line up!
Goals: to design specific modules in order to facilitate the pre-job-briefing, the action, and the verifications

- **To prepare**: Risk analysis / Verification of conditions
- **To act**: Tasks following checking, synchronizations following.
- **To verify**: Tracing, reporting, checking with the pre-job-briefing
New solutions for outage management
General presentation

New solutions for outage management

- Adaptation of US solutions of organization: Outage Control Center, Remote Monitoring Center for Radiation Protection, One Stop Shop, Pre-job Briefing areas...
- Links with Control Room
- Connection with critical operations: audio, video links, teledosimetry...
- Optimization of RP cartographies: initial data, real-time updating
- Shared visualizations

Objectives:

- Reduce the delays of information transfer and decision making
- Improve efficiency and safety for maintenance operators thanks to a direct assistance on critical operations
- Shared and real-time updated visualizations: state of the power plant, (un)availability of systems, fire areas, packing, planning, hazards...
- Specific services to partner suppliers for the monitoring of their operations
What has to be done...

Shared information through innovative dashboards and visualizations

To share as much as possible up to date information on the real progress of field operations

Interactive plans

Lining up progress

Planning

Radiological cartographies
What has to be done…

Communication tools

- DECT under implementation for cell phones
- Audio and video links with critical operations
- Teledosimetry + mobile RP measurement systems

Through wireless and ethernet network (DSL technology)

- Unique integrated interface for video and IS data

To share as much as possible up to date information on the real progress of field operations