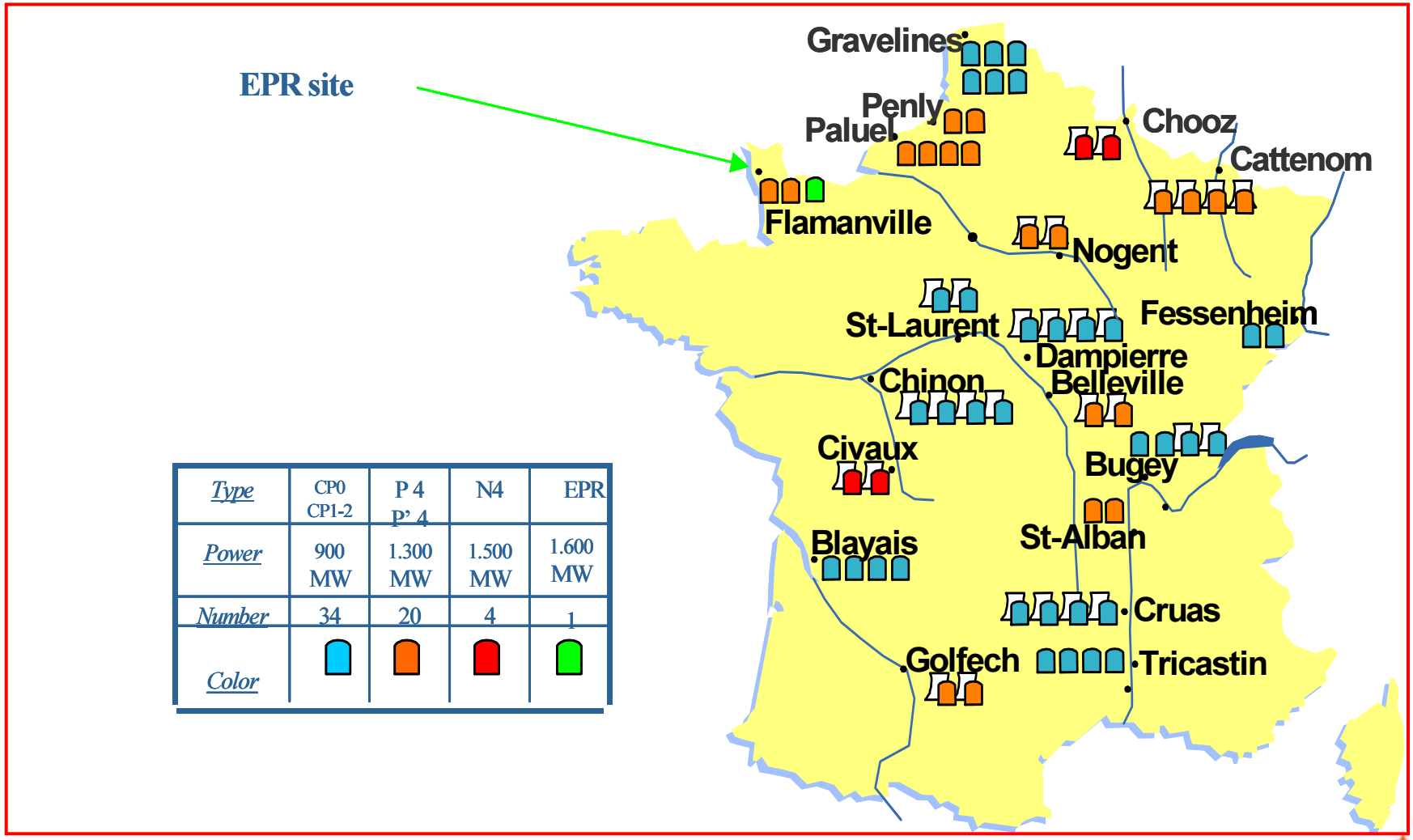
Ageing Management, In Service Inspection and Exceptional Maintenance

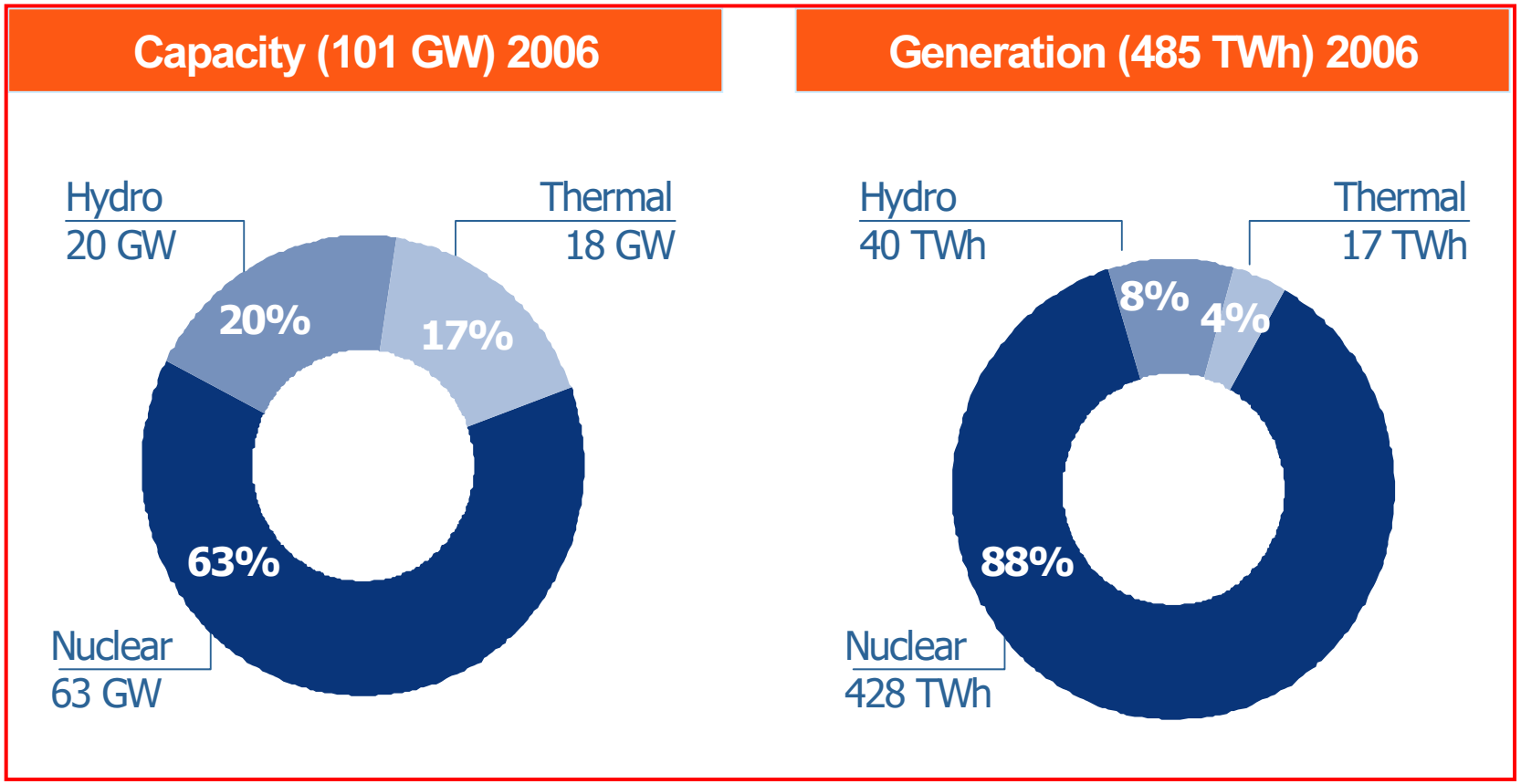
D. Dallery – J.J. Nicolay (Nuclear Operations Division, EDF - France)

EDF PWR Fleet



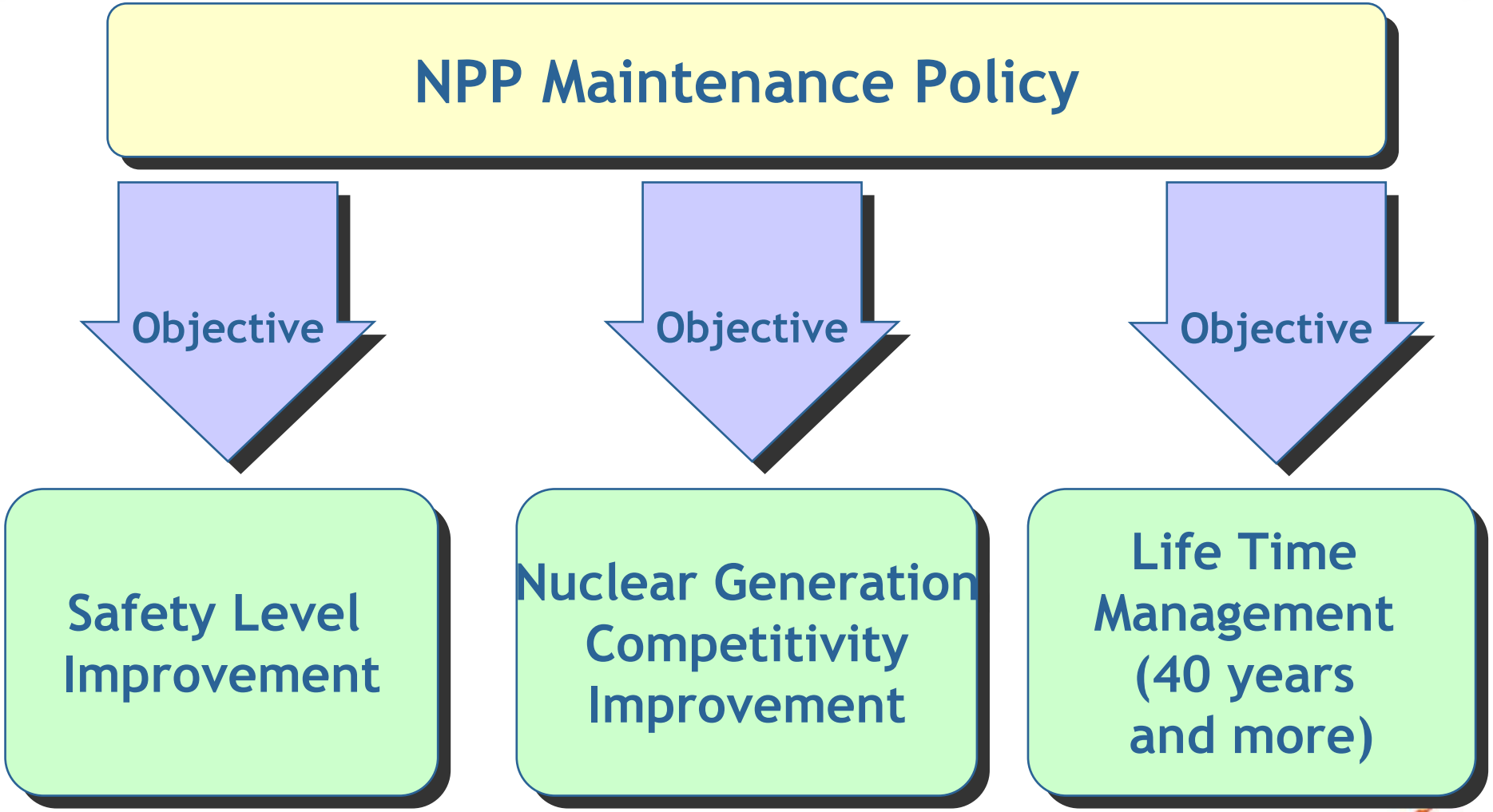
Type	CP0 CP1-2	P 4 P' 4	N4	EPR
Power	900 MW	1.300 MW	1.500 MW	1.600 MW
Number	34	20	4	1
Color				

EDF Generation Capacity in France



More than 95% electricity output is CO2 emission free

Life Time Management and maintenance policy



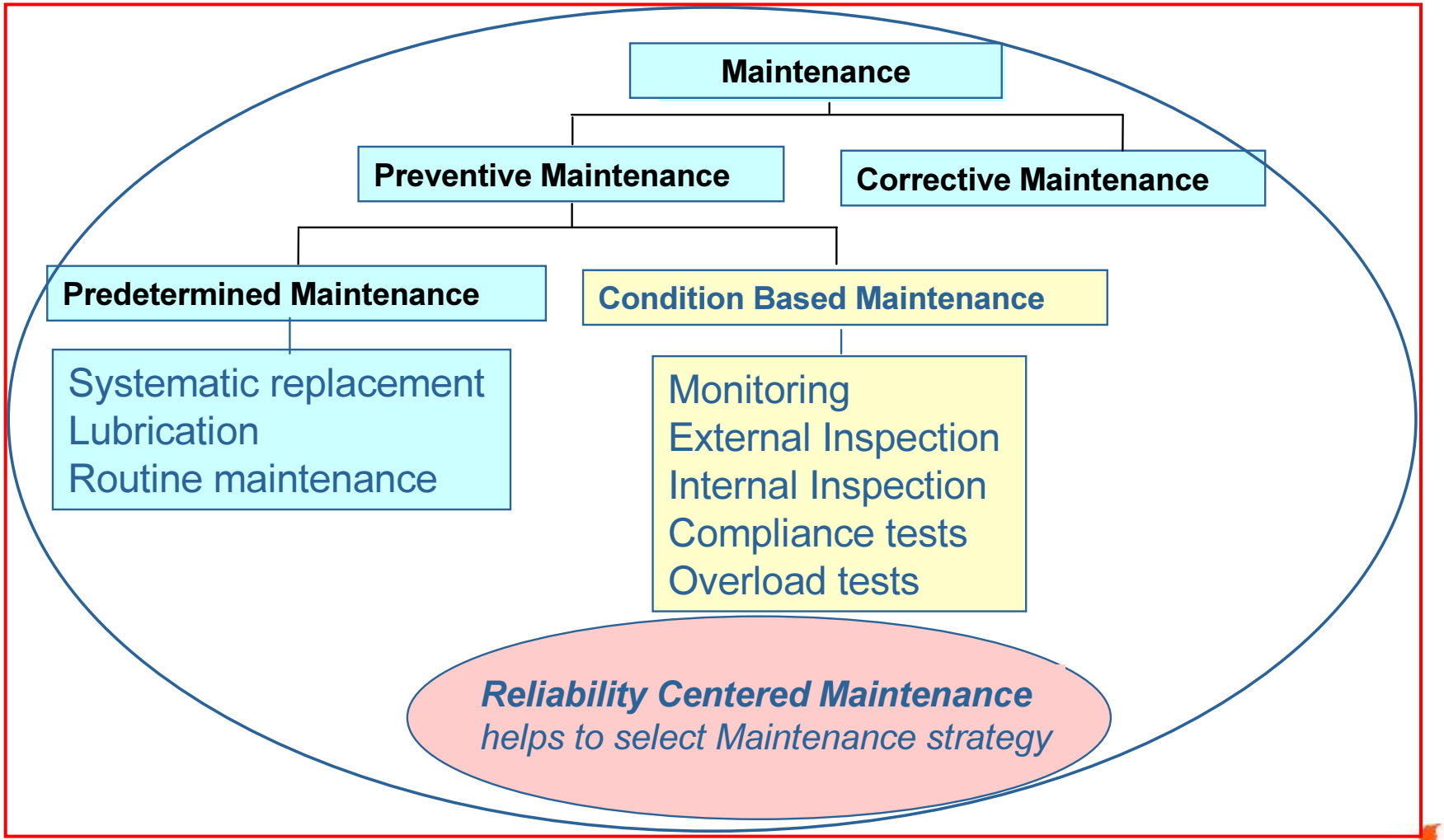
Fields of maintenance

ROUTINE MAINTENANCE (corrective & preventive)

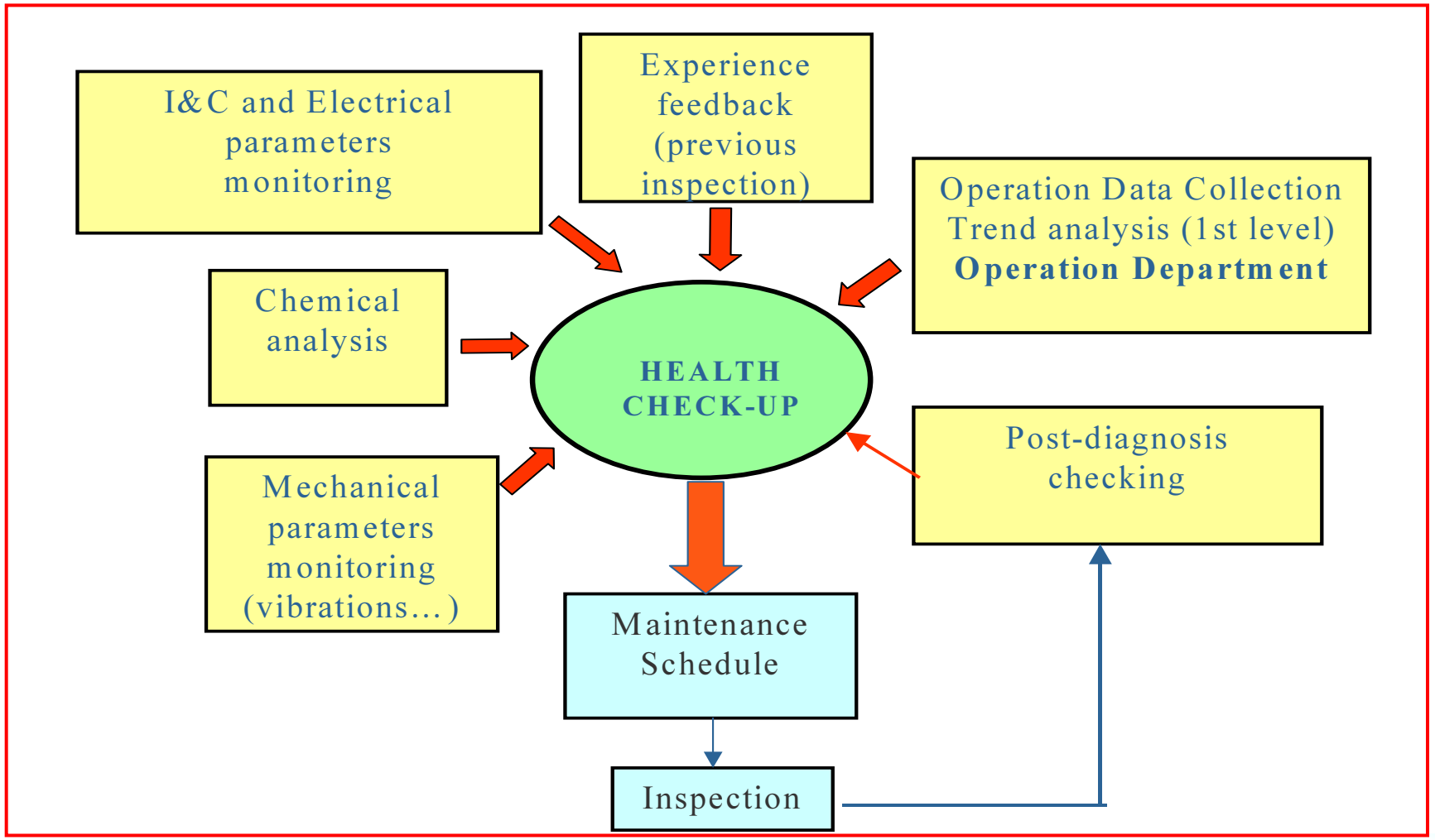
OPERATIONAL EXCEPTIONAL MAINTENANCE

ANTICIPATION EXCEPTIONAL MAINTENANCE

Routine Maintenance Organization



Routine Maintenance : Health Check-up



Operational Exceptional Maintenance

Operational Exceptional Maintenance

- apply to generic hazards or degradations concerning the whole Fleet of NPPs or part of it,
- are decided and planned at national level ,
- are implemented once on a large number of units,
- deal with high costs and/or industrial impacts,
- are planned/implemented on several years.

→ **Proactive Maintenance Strategies**

Operational Exceptional Maintenance

Examples

Nuclear Island

STEAM GENERATORS Replacement (600 MA tube bundle) from 1990 to 2016

RV HEAD Replacement from 1993 to 2009

RHR PIPING TUBES Replacement from 1999 to 2001

1300 MWe DEG CHILLERS Conversion in 2005-2006

Conventional Island

TURBINE LP ROTOR Refurbisment 900 MWe till 2018 (including power uprate)

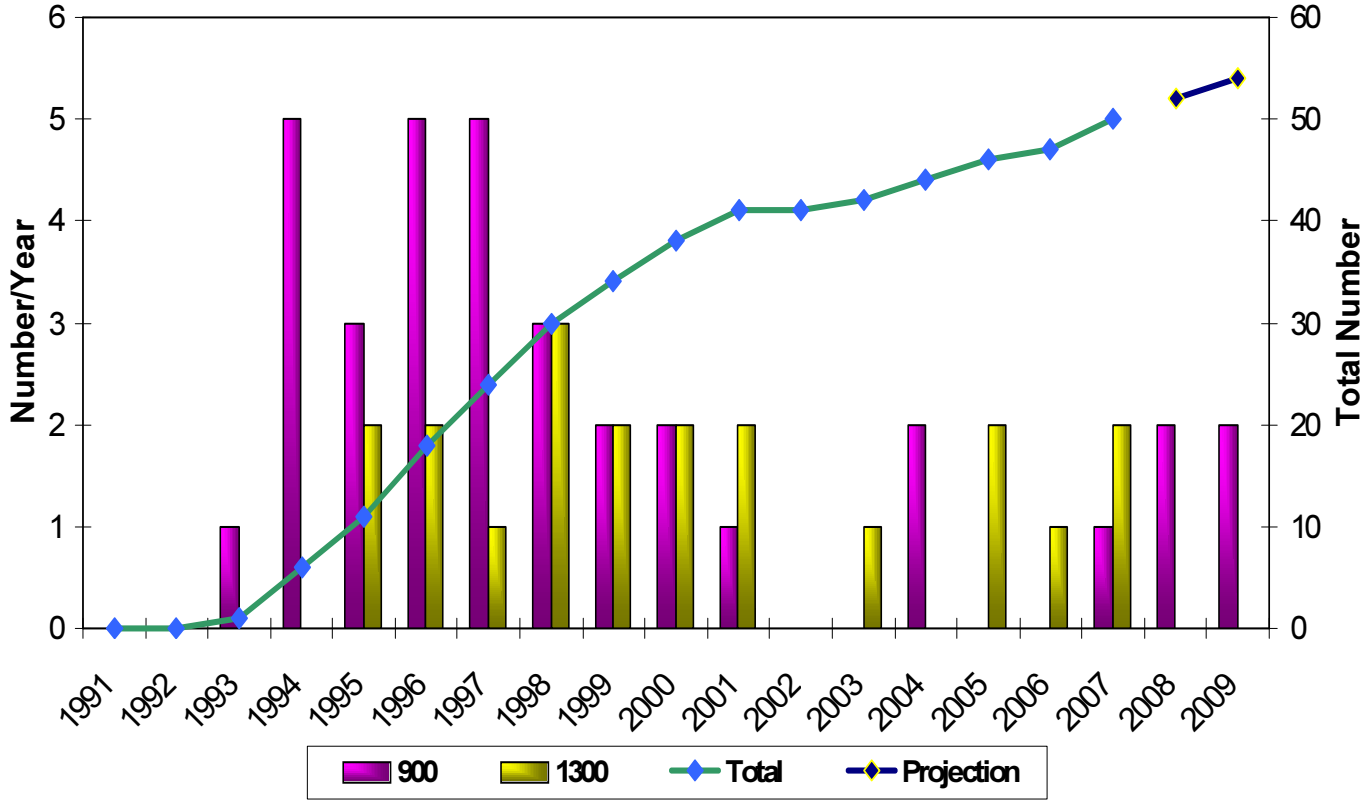
CONDENSER Replacement from 1990 to 2015

GENERATOR STATOR Rewinding or Replacement from 2005 to 2025

Cooling Source

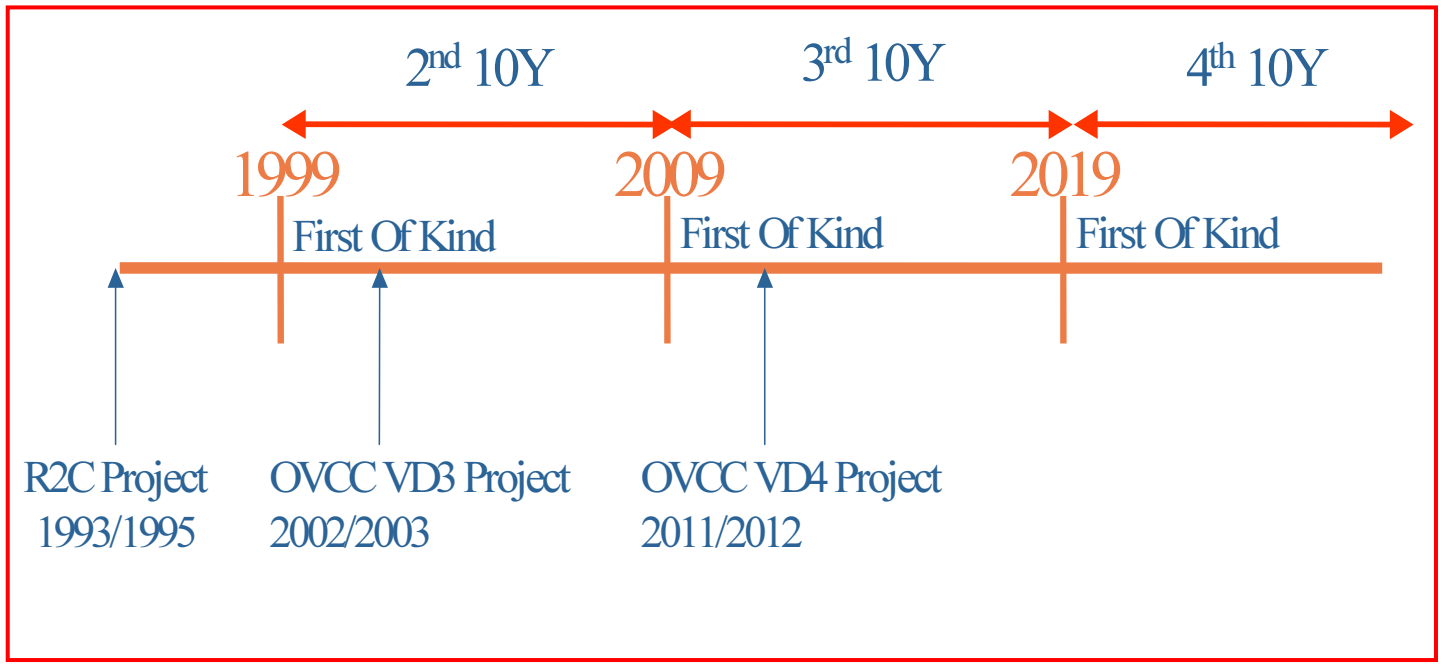
SAFETY Upgrading and PUMPING STATION EQUIPMENTS Renovation

RVH Replacement Program



After Bugey 3 event in 1991 (leakage during Hydrotest on RVH adapter), replacement of all RVHs equipped with Alloy 600 adapters

I&C systems long-term maintenance strategy



- Progressive renovation according to periodic I&C ageing review (« R2C », « OVCC »)
- Strategic stock of spare parts (for several decades)
- Close relationship with I&C Suppliers (Durability contracts)

Anticipation Exceptional Maintenance

Objective :

To anticipate ageing phenomena and to be ready to repair or replace components

Examples :

- Inspection and replacement of CVCS charging line nozzle (anticipation of Thermal Fatigue in mixing zone)

- Reactor Vessel BMI penetration repair (anticipation of PWSCC in Alloy 600 zone)

→ Insurance Files

Anticipation Exceptional Maintenance

Destructive examination of Fessenheim 1 CVCS nozzle

In Service Inspection

Objectives

- **In depth defense :**
  To confirm analysis results showing absence of risks (example : circular welds of main primary pipes)

- **Potential ageing phenomena detection :**
  To detect degradation at the earliest stage on zones identified at risk (examples : mixing zones, turbine blades, Alloy 600 RV BMI penetrations)

- **Ageing phenomena management :**
  To detect and characterize ageing defects (example : PWSCC on Alloy 600 RVH penetrations, FAC on carbon steel pipes)