

Experience of regulatory oversight of EPR Flamanville 3 construction

Autorité de sûreté nucléaire – ASN (France)

Nuclear Power Plants Department



Experience feedback from Flamanville EPR

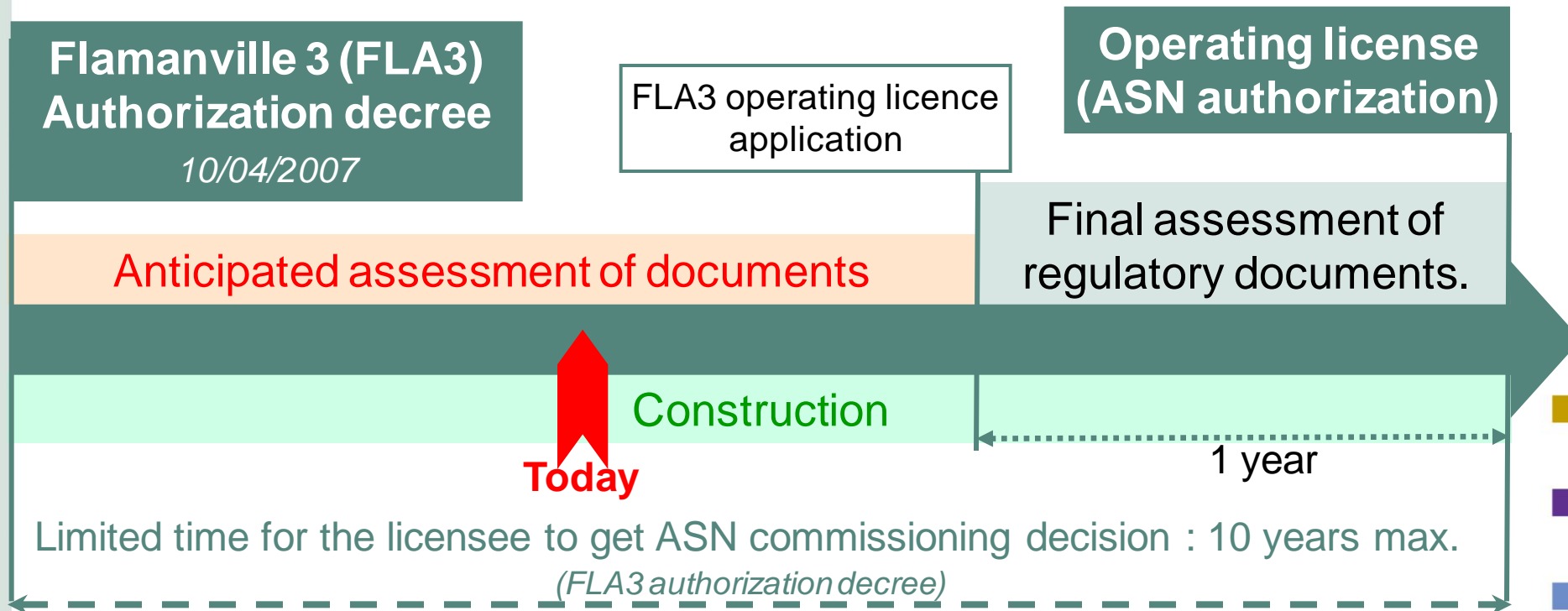
- **ASN oversight activities**

- Current ASN activities
- ASN regulation – Principles
- Principles and implementation

- **ASN main challenges during Flamanville 3 construction**

- **Inspections**

- **Lessons learnt for ASN organization**



▪ Commissioning tests:


- Beginning of the cold tests during the construction period of time
- Beginning of the hot tests (with fuel) after the ASN decision operating license

- **Oversight construction of Flamanville 3**

- To ensure its quality and its ability to comply with safety, radiation protection and environmental requirements
- Way to proceed
 - Assessment of detailed design of SSCs
 - Inspection of construction activities: on-site Flamanville 3, in manufacturers or providers workshops
 - Assessment and regulation of the hazards that EPR construction may induce on the two adjacent operating nuclear plants and vice versa
 - Assessment of main non-compliances
 - Assessment of events relevant to safety or radiological protection
 - Industrial safety inspections (safety of workers)

- **Anticipated assessment of the regulatory documents to be part of the operating license application**

- **Fundamental principle**

- The plant operator () has the primary responsibility for safety
- As a consequence, this operator has to ensure the quality, the control and the supervision of the construction activities
 - except for the pressure nuclear systems which are, by law, under the responsibility of the manufacturer

- **ASN activities scope (established by the TSN Act June 13, 2006)**

- Safety, public health, protection of nature and environment, workers safety including radiation protection

- **Regulations not specific to nuclear installation**

- Radiation safety (labor code, public health code)
- Occupational health and safety (labor code)
- Environmental protection (environment code)
- Stakeholder involvement (environment code)

- **One major TSO to support ASN work :**

- Institute for radiation protection and nuclear safety

The logo for IRSN (Institut de radioprotection et de sûreté nucléaire) consists of the letters 'IRSN' in a bold, sans-serif font. The 'I' and 'R' are red, the 'S' is blue, and the 'N' is red.

• Objectives of ASN oversight

- to ensure that the plant operator and the pressure nuclear systems manufacturers do implement their responsibilities
- to review the reactor construction in order to be confident on the safety level of the construction activities
- to verify that the installation as-built complies/will comply with national regulations and ASN requirements

to check that the plant construction activities are performed in accordance with :

- The regulatory requirements
 - Regulation concerning nuclear pressure equipments
 - Order concerning quality management of the operator
 - Authorization decree for FLA3 and associated ASN licence conditions
- The safety case provided by the licensee to get the authorization decree (preliminary safety analysis report...)
- The technical guidelines for new PWR endorsed in 2004 by ASN for EPR
- The state-of-the-art construction practices and the conventional labour regulation

Principles

① Graded approach

In line with the importance of activities for :

- safety
- radioprotection
- environment
- safety of workers

② Event related oversight

Implementation

- “Sampling” of activities in accordance with the safety, the radiation protection or environmental importance of the topics
- Exhaustive inspections dedicated to some nuclear pressurized components
- Local ASN Division (Caen)
- ASN Nuclear Pressure Equipment directorate
- ASN Nuclear power plants directorate

↪ **dedicated teams**



ASN oversight

Principles and implementation



IRSN

DEP

Nuclear Pressure equipments

- Detailed design review
- Inspections of manufacturing activities
- Management and supervision of third-party bodies
- Non-compliances follow-up

DCN

Oversight policy

Detailed design oversight activities

- Assessment with IRSN input
- Inspections

Local ASN division (Caen)

Construction oversight activities

- Inspections
- Non-compliance follow-up
- Workers safety
- Hazards that EPR construction may induce on the two adjacent operating NPPs and vice versa

Detailed design activities

- Technical assessment

Construction activities

- Involvement in inspection program accomplishment
- Non-compliance assessment

Third-party bodies to perform inspections related to the nuclear pressure equipment manufacturing

- **Transition from design to construction**
 - No predefined hold point
 - Except for some pressure nuclear equipments, where some hold point can be imposed by ASN to assess conformity
- **Based on operator or ASN findings for all phases, ASN can impose a hold point on an observed problem**
 - Regulatory basis: ASN prescriptions (licence conditions) linked to Flamanville 3 authorization decree
 - The operator must satisfy ASN that appropriate corrective measures have been implemented to allow progress
 - ① Such hold points have already been imposed



Regulations for design and manufacturing of nuclear pressure equipments

- French regulations were historically applied to all types of pressure equipment
- Regulations for nuclear pressure equipments (NPE) provide additional requirements which take into account the safety of the plant and the risks due to radioactivity. The aim of these regulations is to offer additional guarantees on the quality of the equipment.
 - Essential safety requirements (ESR): $\text{NPE requirements} = \text{PED Requirements} + \text{additional requirements}$
- The manufacturer should meet the ESR which are defined as goals to achieve.
 - The equipment is subject to a **conformity assessment** of the ESR
 - Assessment performed by ASN and third party inspection body.
 - The manufacturer must also demonstrate that the codes and standards it uses to manufacture the equipment meet ASN's requirements.



Regulations for design and manufacturing of nuclear pressure equipments

- **Conformity assessment**

- For major components, conformity assessment is done equipment by equipment
- For each equipment: assessment of the design and inspection of manufacturing steps, to verify conformance with essential safety requirements.

- **ASN ensures a surveillance of third-party bodies (notified and accepted by ASN).**

- **NPE cannot be commissioned if essential safety requirements (ESR) are not met**



Experience feedback from Flamanville EPR

- ASN oversight activities
- ASN main challenges during Flamanville 3 construction
- Inspections
- Lessons learnt for ASN organization

- **Flamanville 3 = first of a kind**

- **Issue:**

- The cost of detailed design would be too high for the industry to finance without the confirmation of having at least one launch order
 - Introduction of new SSCs in comparison with the operating reactors

- **Consequences:**

- Preliminary safety analysis report sometimes not detailed enough to perform some inspections (more information needs to be provided)
 - Detailed design is moving (adequacy and consistency issue...)
 - Teams performing the assessment have to learn about new SSC

- **New regulations in force**

- **Timeframe**

- 2005: new regulation for pressure nuclear equipments
 - AREVA and EDF decided to use it for Flamanville 3
 - 9th May 2006 : EDF submitted its formal authorization application
 - 13th June 2006 : Act on Transparency and Security in the Nuclear Field (TSN-Act)
 - **4th April 2007** : Flamanville 3 authorization decree signed by Prime Minister
 - 2nd November 2007: Decree related to nuclear facilities and the regulation of the transport of radioactive materials
 - Gives the detail of the process to get a authorization decree and a commissioning authorization
 - 26th September 2008 : ASN issued a resolution establishing requirements (i.e. licence conditions) for the detailed design and control for Flamanville 3

- **Consequence:**

- the review of the EDF application and the pressure nuclear equipments oversight began with the “old” regulations but took into account some of the new requirements of the TSN-Act and of pressure nuclear equipments regulation

- **After a 10 years period without construction of new NPPs in France**
 - Latest NPP construction in France : Civaux (N4 series)
 - Civaux 1: construction started late in 1988, first criticality in November 1997
 - Civaux 2: construction started early in 1991, first criticality in November 1999
 - **Challenge:**
 - Loss of companies familiar with NPP construction requirements
 - Loss of skilled people
 - **Consequences:**
 - A relearning stage for the licensee, the manufacturers, the subcontractors...as well as for ASN and IRSN
 - To revisit past practices and establish current practices
 - **ASN aim:** to ensure that all actors involved in NPP construction have a construction experience feedback process to learn from on-going construction and to smooth any future potential construction projects



Experience feedback from Flamanville EPR

- **ASN oversight activities**
- **ASN main challenges during Flamanville 3 construction**
- **Inspections**
 - ASN inspections practices
 - Flamanville 3 - Inspection program development
 - Current status of ASN inspection program development
 - ASN tools developed for inspection activities
 - Occupational health and safety, labor issues
- **Lessons learnt for ASN organization**

- **Inspections:**

- Are either unannounced or notified to the licensee a few weeks before the site visit
- Takes place:
 - mainly on the site or during the course of the relevant activities;
 - in the head office departments (or design and engineering departments) at the major nuclear licensees
 - in the workshops or engineering offices of the subcontractors, the construction sites, plants or workshops manufacturing the various safety-related components
- Are usually carried out by two inspectors, with the support of an IRSN representative (expert for the facility or the topic)
 - ASN can mandate third-party bodies to perform inspections related to the nuclear pressure equipment manufacturing

- **No resident inspector**

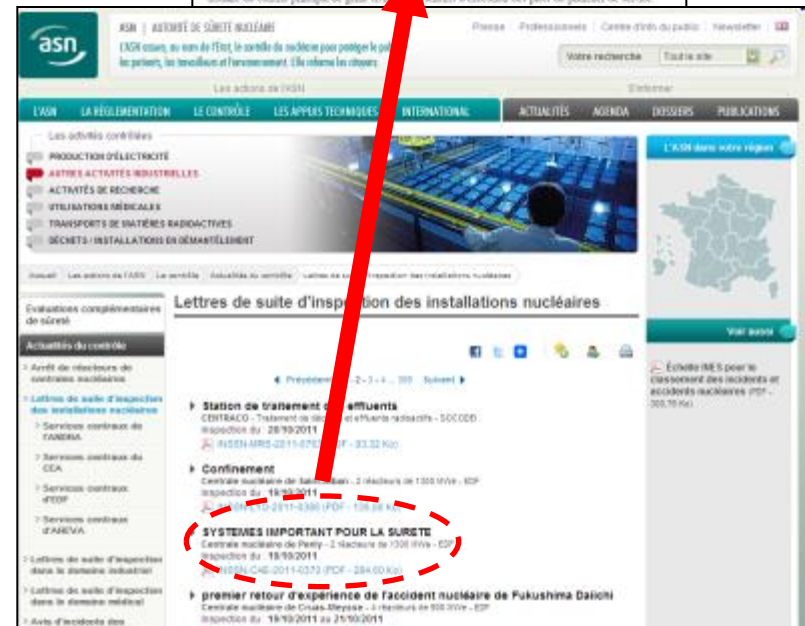
- In order to maintain the operator responsibility
- ASN Caen division is less than 2 hours drive of Flamanville NPP

- Each inspection in a nuclear facility gives rise to :

- At the end of the inspection, a factual record of major negative findings (signed by the inspectors and the licensee's representative)
- A few weeks (~3 weeks) after the inspection :
 - A follow-up letter to the licensee stating, in addition to an overall synthesis of the main positive and negative findings :
 - anomalies in the facility or aspects warranting additional justifications
 - deviations between the situation observed during the inspection and the regulations or documents produced by the licensee pursuant to the regulations
 - ASN requirements to correct, within a fixed period of time, the deviations or non compliances observed by the inspectors or to improve the situation

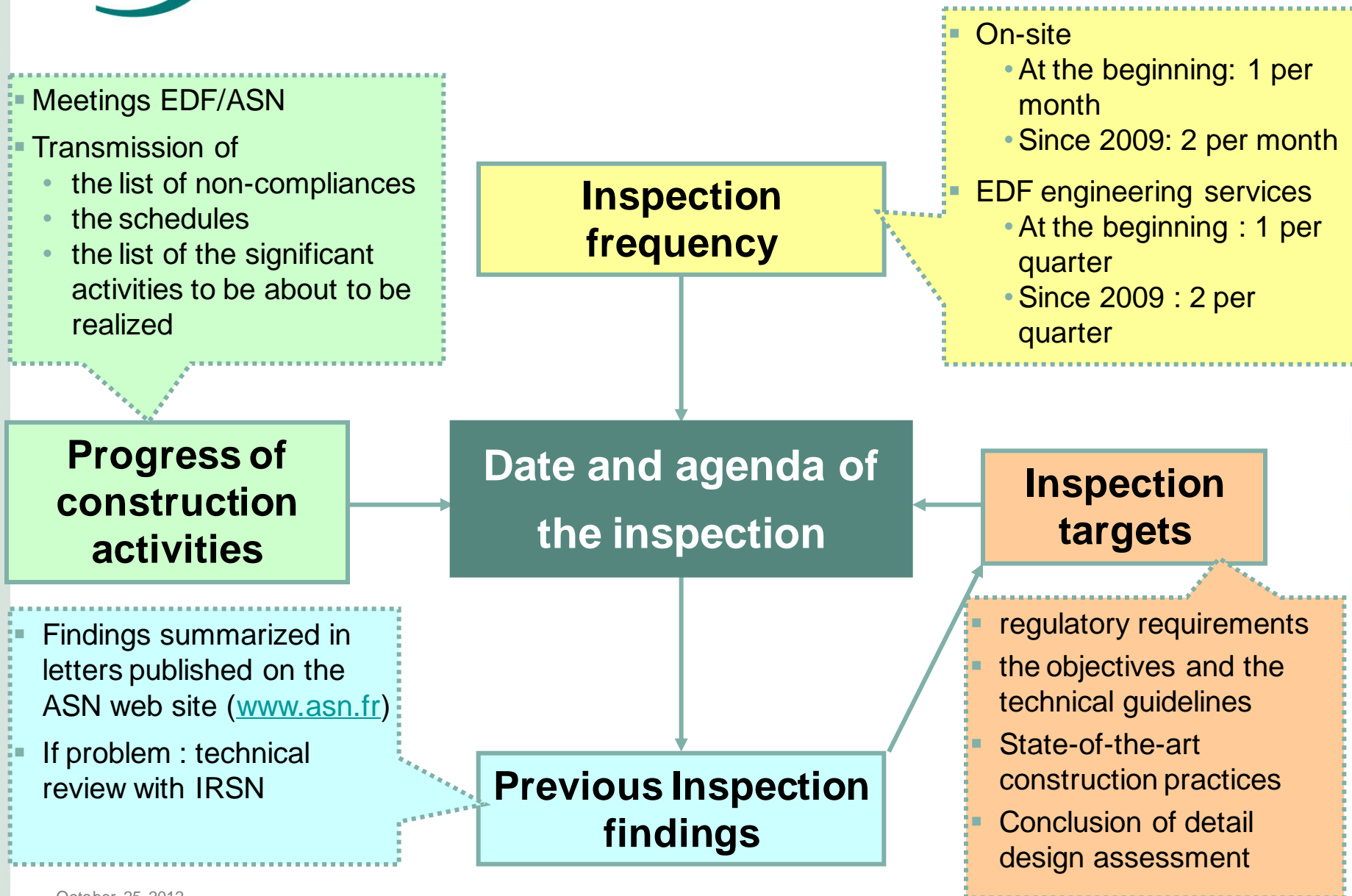
- An inspection report which is restricted to ASN

- Inspection follow-up letters are available on ASN web site (www.asn.fr).



Flamanville 3

Inspection program development





ASN tools developed for inspection activities (2/2)

- **Current ASN human resources**

- Caen regional office (150 km from Flamanville): to oversight construction activities on-site :
 - 4 dedicated inspectors → specific training (construction activities, civil works, mechanical erection...)
 - One dedicated to health and safety
- Headquarters
 - NPP department: to manage the assessment of documents related to the commissioning phase and to oversight engineering offices and equipments facilities
 - 3 full time equivalent inspectors
 - NPE department: to manage the assessment of pressure equipments (detailed design assessment, management and supervision of third-party bodies, inspections)
 - 3 full time equivalent inspectors
 - + IRSN support: about 20 equivalent engineers

- **Link between detailed design – inspections ensured by:**

- Good communication between local inspectors and ASN services in charge of detailed design assessment
- Support of IRSN experts involved in detailed design



Inspections by ASN – Flamanville 3

Number & topics - annual synthesis

- **Since 2008, about 24 inspections per year at FLA3**
 - Civil structures
 - Mechanical structures
 - Electrical equipments
 - Quality management
 - EDF organization
 - Contractors oversight
 - Radiation safety (NDT)
 - Environment protection
- **Since 2008, about 8 inspections per year in EDF engineering departments or equipment providers (EDF subcontractors)**
- **Nuclear pressure equipment manufacturing: ~1000 inspections by approved 3rd party and a few ASN inspections per year**
- **Occupational health & safety and labor code (a dozen per year)**

Control of construction

Hazards (construction \Rightarrow operating units)

- **Hazards generated by construction:**

- Cranes: no consideration by the operator of the risk of a falling crane on FLA2
- Blasting, dust: in 2007, some stones were thrown on FLA2 diesel generator building
- Protection of power cables during gallery digging: in 2010, a contractor (civil work company) damaged the power cable

- **Main causes:**

- Lack of questioning attitude
- Lack of cooperation between the two operating nuclear plants and FLA3
- Lack of communication on site



- **Cracks in basemat (2008)**

- Cracks ran the full depth of the first layer for the reactor building basemat, caused by lack of reinforcement steelwork at the level where pouring was stopped
- ASN set an hold point

- **Construction joints (2008-2010)**

- 2008: Impossibility to access the joint, for joint preparation, due to high density of steel
- 2009-2010: Use of unapproved chemical products (deactivator) for joint treatment in state of pressurized water and air

- **Liner welding (2008-2011)**

- 2008: High level of repairs especially on reactor building basemat area
- 2010: High level of repairs (cylindrical part of liner)



Control of construction

Manufacturing of main RCS components

- **FLA3 pressurizer shell manufacturing**
 - Use of a non qualified electrode to perform some Pellini tests
- **FLA3 steam generator shell manufacturing**
 - Wrong position for the hole of MFWS pipe
- **FLA3 Vessel head**
 - 2010: defects in several nozzle penetration welds
 - 2011: inadequate buttering of nozzle penetration welds

- **Some lack of:**
 - Preparedness
 - Not enough consideration of the impact of an activity on another one
 - In the beginning, practices developed to optimize mainly schedule, underestimating quality impact
 - Old practices are given up: new ones have not always been tested
 - Communication
 - On site
 - Between engineering departments and on site departments
 - Appropriation of the requirements of the construction code and common civil works rules
 - Consistency between detailed design and on site practices
- **Some shortcomings in management and surveillance of the subcontractor chain**

- **Not enough use of experience feedback**
 - Experience feedback of first events was not implemented quickly enough
 - Experience feedback of a construction activity is not used for the beginning of another construction activity
- **The operator has to ensure that it is possible to comply with requirements and that they are indeed necessary**
 - Operator proposals: to get out of the construction code (ETC-C) the technical requirements which were difficult to be complied
 - Refused by ASN
- **Way to improve the situation**
 - To consolidate construction experience feedback
 - To develop exchange between regulatory bodies
 - To ensure that the international experience feedback is shared between licensees
 - To define with the licensee an event reporting system and communication scale

Control of construction

Non conformances and their impact

- **A series of non conformances during the construction**
 - Some are detected by the manufacturer and the licensee
 - Some are detected by ASN and its TSO
 - Some leads to the use of regulatory and coercive tools and additional specific assessment
- **But today no real impact for the future commissioning of the reactor**
 - Non-conformances are corrected or technically justified (on ASN demand or on operator behalf)
 - Extensive new assessment
 - Re-manufacturing or repair of some equipments/structures
 - Additional inspections
 - Nevertheless: the number of non-conformances is an indicator reflecting a perfectible quality management and surveillance of activities by the licensee and the manufacturer



Experience feedback from Flamanville EPR

- **ASN oversight activities**
- **ASN main challenges during Flamanville 3 construction**
- **Technical assessment**
- **Inspections**
- **Lessons learnt for ASN organization**

- **Regulatory tools are in place to ensure:**
 - Consistent and responsive processes
 - Large scope oversight
- **Ensure sufficient human resources dedicated to dealing with:**
 - Elaboration of methodologies to define the way to proceed
 - how to apply new regulation in force
 - 2005: new regulation for pressure nuclear equipments
 - 13th June 2006 : Act on Transparency and Security in the Nuclear Field (TSN-Act)
 - 2nd November 2007: Decree related to nuclear facilities and the regulation of the transport of radioactive materials
 - how to apply regulation to a NPP under construction, specially to FOAK
 - Public communication demands
 - International cooperation needs