



IBIX[®]
SPECIAL CLEANING

DECONTAMINATION

IN NUCLEAR POWER STATIONS

using the

IBIX[®] SYSTEM



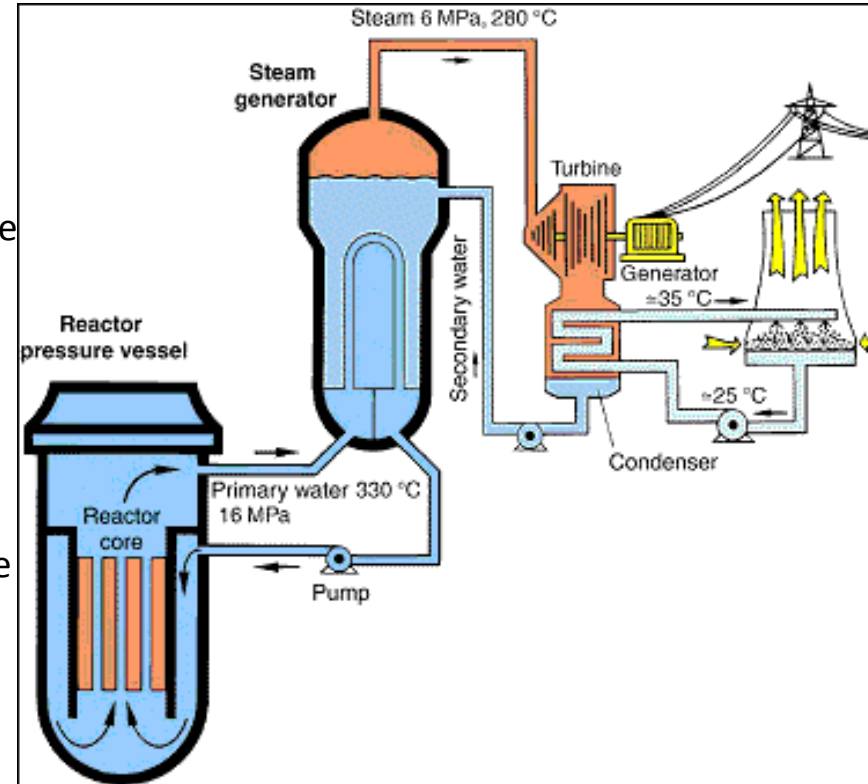
Summary

- Origin of contamination
- Machine and Product
- Homologation of concept IBIX
- Performance of system IBIX
- Advantages and disadvantages

ORIGIN OF CONTAMINATION

Operating principles of a nuclear power plant.

- Due to the nuclear reaction which occurs in the reactor, the water in primary circuits is heated
- The primary water is directed to a steam generator, where a thermal exchange with the secondary water occurs
- Consequently, the secondary water is heated to steam, and is then directed to a turbine.
- The induced rotation of the turbine drives the rotation of a rotor around a stator
- This rotation generates an electromagnetic field which induces the production of electricity.





Origin of contamination

- Due to nuclear activity, there are different results of contamination, which are localised in the regulated area (near the primary circuits):

⇒ Surface contamination by radioactive nuclides, both fixed and free.

⇒ This contamination causes radiation and surface contamination, both of which are harmful to human health.

Surface contamination needs special treatment, to clean the parts which are contaminated

Cleaning contaminated tools and parts is very important, because it permits re-use without creating additional unnecessary hazards to human health and the environment.

PRODUCT
&
MACHINE

Sodium Bicarbonate

Formula	NaHCO_3
Form	Crystalline powder
Nature	Inert
Color	White
Thickness	2,5 Mohs
Density	0,98



⇒ **Medias especially developed for the application with IBIX**

- **Features :**

- Ultra pure compound ($[\text{NaHCO}_3] > 99\%$) especially calibrated
- Soluble in water
- Bio degradable
- Non toxic for the environment and human health

IBIX blasting system

⇒ **Wet process mode recommended indoors to avoid any generation of dust**

- **2 IBIX equipment versions:**
 - * **IBIX 9F2 + water spray kit**
 - * **IBIX H₂O**

- **Advantages**

⇒ Elimination of dust by formation of a very fine water bell nebulized outgoing of a special nozzle

⇒ Reduced water consumption



HOMOLOGATION
OF
PROCESS

CHRONOLOGICAL EVENTS

- March 2007 : Tests of mechanical compatibility carried out by a certified laboratory
- April 2007 : PMUC Homologation of Sodium Bicarbonate :
- July 2007 : **Purchase of the first IBIX machine by the nuclear power station of Bugey**
- Summer 2007 : Beginning of the performance tests
- September 2007 : Tests of chemical compatibility carried out by a certified laboratory
- April 2008 : Presentation of the IBIX concept at the “Decontamination Conference” organized by CEIDRE
- May 2008 : **Homologation** of IBIX Decontamination Process

TESTS OF COMPATIBILITY

Tests on different types of alloy :

⇒ steel, stainless steel, aluminum, brass, bronze

- **Mechanical measure**

⇒ Loss of thickness 100 times lower than the “pass” requirement

- **Chemical measure**

⇒ Loss of thickness 100 times lower than the “pass” requirement

- **Localized chemical corrosion**

⇒ No trace of corrosion noticed

EFFECTIVENESS
OF
THE PROCESS

EFFECTIVENESS OF SYSTEM

- Criteria of effectiveness :

FRDF : Factor of Reduction of Dose Flow

which corresponds to the benefits in health hazards control

FRDF > 5 (EDF criteria)

FD : Factor of decontamination which represents the performance level

EDF : Equivalent flow of dose which represents the effects on the users' health.

Treated parts	Camera support	Valve	Pipe	Filter
Surface condition	Clean	Rusted	Greasy	Very dirty
EFD max before (mSv/h)	Bdf	4	3	6
EFD max after (mSv/H)	Bdf	1,2	0,3	1,2
FRDF	/	3,3	10	5
Contamination before (c/s)	6000	> 10 000	> 10 000	> 10 000
Contamination after (c/s)	< 50	< 30 No more rust	< 10 no more grease	< 20 clean
FD	120	>300	>1000	500
Time of decontamination	30 min	15 min	30 min	15 min
Consumption of media	10 Kg	3 kg	1 kg	3 kg
Integrated dose (mSv)	0,05	0,01	0,04	0,02

Examples of treated parts



Comparative studies with chemical process

1. IBIX / Oxydo-reduction

⇒ 3 to 6 times more effective

⇒ Process easier to use

⇒ Generates 2 to 3 times less effluents

⇒ 2 times quicker

2. IBIX / Foam

⇒ 3 times more effective

⇒ Only one treatment with IBIX

ADVANTAGES

- Replaces the use of chemical products such as foams and solvents typically used for decontamination.
- No more need for “manual brushing”: one IBIX treatment followed by rinsing is enough.
- Very effective in areas difficult to reach (hollows, corners, grooves...)
- Time-saving and improved effectiveness
- Less production of effluents
- Reduced absorbed dose for the users

PROCESS CONDITIONS

- Working in an enclosed booth with Muruora equipment for highly contaminated materials.
- Using ear protection in case of prolonged use.



GOOD PRACTICE

- The IBIX Decontamination Process has been specified in the **ALARA register of good practice.**
- The Nuclear Power Station workers need to use the best process in terms of :
 - Performance
 - Generation of effluents
 - Health Protection

BUSINESS DEVELOPMENT OPPORTUNITIES

- Services providers : cleaning of contaminated plant
- Recycling of nuclear consumables
- Medical: treatment of medical radioactive waste