Nuclear decontamination expert with chemical solutions for nuclear maintenance and decommissioning

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Content

- Company presentation
- Type of contamination
- Foam decontamination
- Wiping decontamination
- Gel decontamination
- Gel auto dry decontamination
- Peelable protective film
- Fixative film
- Specific application
- Skin decontamination

History

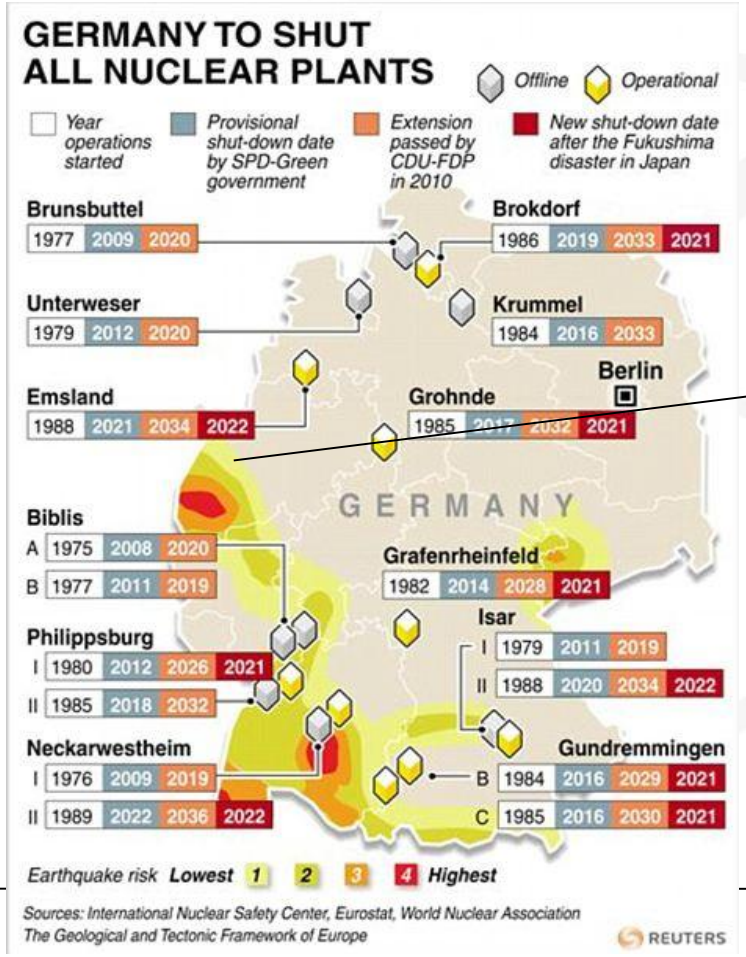
- FEVDI is family own business founded in 1968, by Mr. Lucien GALLO
- FEVDI has more than **50 years of** experience in **nuclear chemical decontamination**
- **Location near Lyon, France**

France has 57 reactors units

24 rue Louis Pradel 69960 Corbas, France

Offices

- **German office:** addressing German nuclear decommissioning market



Siegburger Str. 231, 50679 Köln, Deutschland

Capabilities

- **Formulation and R&D laboratory**
- **Production facility**: Mixing tanks up to 4000 L, demineralized water installation.
- **Conditioning facility**: 5L to 1000L
- **Maximal area storage** : 1500 m²,
- **Manufacturing capability:**
  - Liquid: 600 t/year,
  - Gel : 50 t/year,

Capabilities

- **Dedicated production line for nuclear wet impregnation towel.**

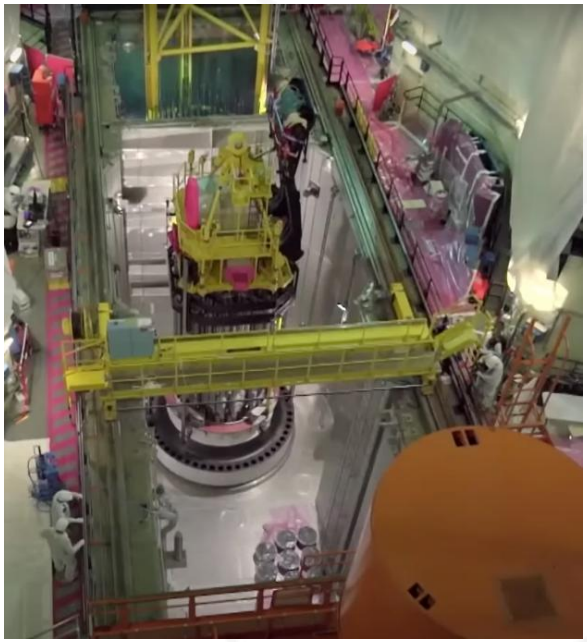
- **Custom-made capability**

Capabilities

- **Assembly workshop for spraying equipment**

Market

Nuclear maintenance
Decontamination
during outage



Decommissioning
Deep decontamination
of metallic part

Defense and CBRNe
Decontamination
in case of accident

Our key customers

France: 70% market share

End user – Utilities

EDF

orano

CEA

ASNR

Services and maintenance companies

aemo

ALTRAD

ENDEL

BOUYGUES CONSTRUCTION SERVICES NUCLÉAIRES

DERICHEBOURG

EQUANS NUCLEAR

ÉTANDEX

framatome

GSF

GE Energy

KAEFER

NETMAN

NUVIA

OMS

ONET TECHNOLOGIES

ORTEC GROUP

VEOLIA

SAMSIC

SPIE

Séché énergies

Séché global solutions

Westinghouse

Our international customers

Belgium

Germany

Italy

Romania

Sweden

Finland

Czech Republic

Switzerland

UK

Our international customers

Canada

USA

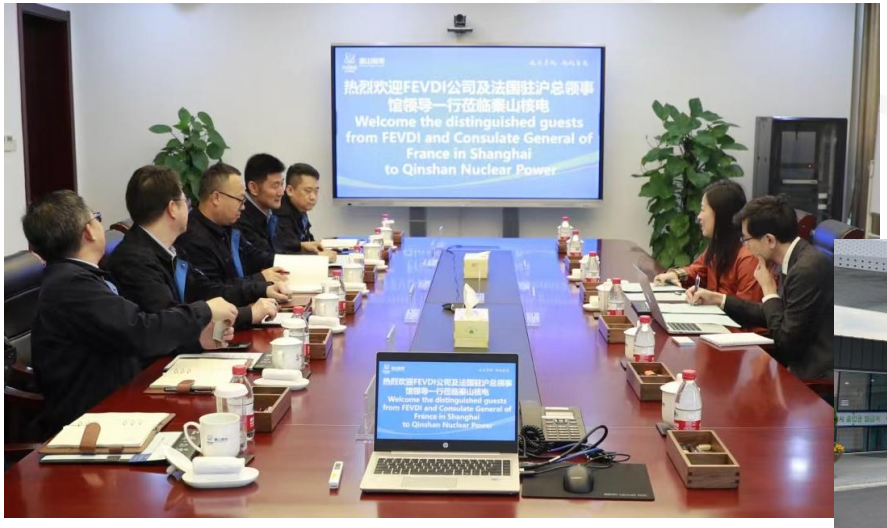
Our international customers

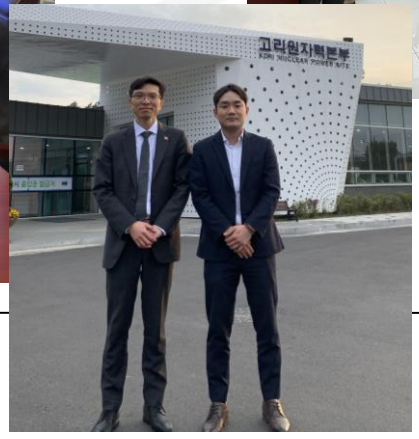
China

Japan

South Korea

Korea Atomic Energy Research Institute





Our international customers

UAE

شركة نواة للطاقة
Nawah Energy Company

Turkey

monrol

Type of contamination

Contamination

Removable or loose
Contamination on the surface or suspension

Fixed
Contamination highly penetrated to the material

Choice of decontamination solutions

- The choice of the decontamination process and product depends on
  - The aim of decontamination:
    - Maintenance
    - Waste sorting
    - Dismantling
  - The material characteristic (shape, type)
  - Contamination characteristic (mSv)
  - Type of final secondary waste treatment (liquid, solid)
  - Risk for on-site personnal
  - Cost

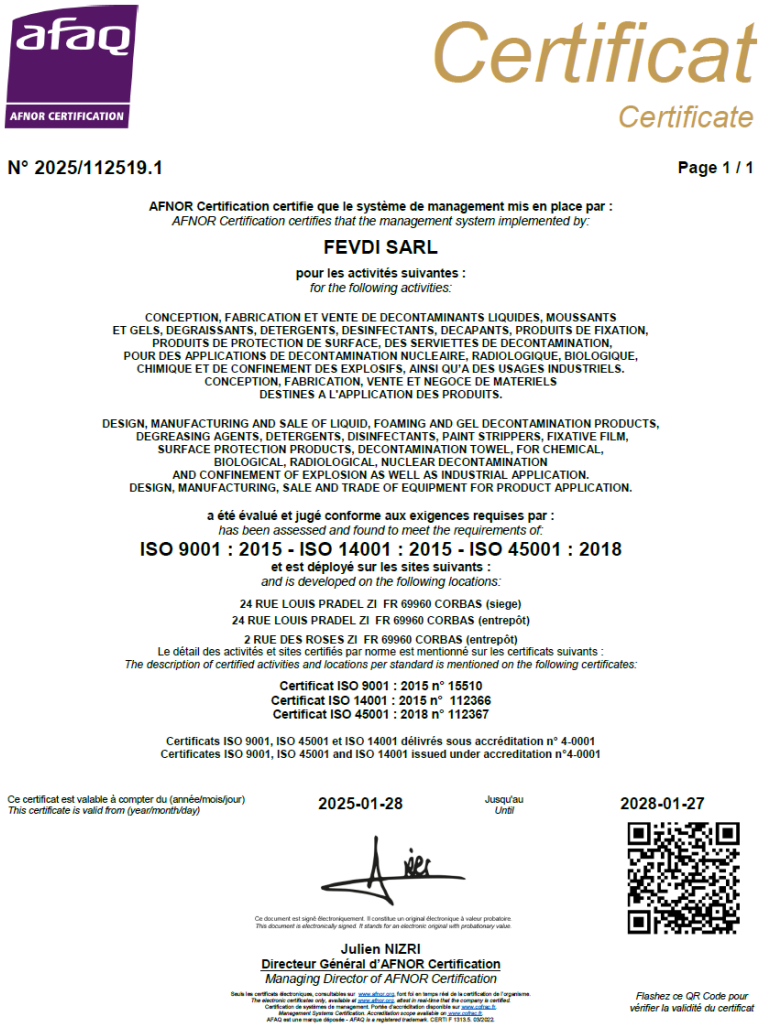
Depending on your needs and constraints, our experts can suggest you the most suitable products for your project.

Qualifications

- FEVDI is certified ISO 9001 version 2015 since 1997
- FEVDI has also ISO14001 and ISO45001
- FEVDI is compliant with REACH *(European Union Regulation concerning the registration, evaluation, authorization and restriction of chemicals)*
- FEVDI product are PMUC certified by EDF label

PMUC

Produits et Matériaux Utilisables en Centrales



afaq AFNOR CERTIFICATION

Certificat

Certificate

N° 2025/112519.1 Page 1 / 1

AFNOR Certification certifie que le système de management mis en place par :
AFNOR Certification certifies that the management system implemented by:

FEVDI SARL

pour les activités suivantes :
for the following activities:

CONCEPTION, FABRICATION ET VENTE DE DECONTAMINANTS LIQUIDES, MOUSSANTS ET GELS, DEGRAISSANTS, DETERGENTS, DESINFECTANTS, DECAPANTS, PRODUITS DE FIXATION, PRODUITS DE PROTECTION DE SURFACE, DES SERVIETTES DE DECONTAMINATION, POUR DES APPLICATIONS DE DECONTAMINATION NUCLEAIRE, RADIOLOGIQUE, BIOLOGIQUE, CHIMIQUE ET DE CONFINEMENT DES EXPLOSIFS, AINSI QU'A DES USAGES INDUSTRIELS. CONCEPTION, FABRICATION, VENTE ET NEGOCE DE MATERIELS DESTINES A L'APPLICATION DES PRODUITS.

DESIGN, MANUFACTURING AND SALE OF LIQUID, FOAMING AND GEL DECONTAMINATION PRODUCTS, DEGREASING AGENTS, DETERGENTS, DISINFECTANTS, PAINT STRIPPERS, FIXATIVE FILM, SURFACE PROTECTION PRODUCTS, DECONTAMINATION TOWEL, FOR CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR DECONTAMINATION AND CONFINEMENT OF EXPLOSION AS WELL AS INDUSTRIAL APPLICATION. DESIGN, MANUFACTURING, SALE AND TRADE OF EQUIPMENT FOR PRODUCT APPLICATION.

a été évalué et jugé conforme aux exigences requises par :
has been assessed and found to meet the requirements of:

ISO 9001 : 2015 - ISO 14001 : 2015 - ISO 45001 : 2018

et est déployé sur les sites suivants :
and is developed on the following locations:

24 RUE LOUIS PRADEL ZI FR 69960 CORBAS (siege)
24 RUE LOUIS PRADEL ZI FR 69960 CORBAS (entrepôt)
2 RUE DES ROSES ZI FR 69960 CORBAS (entrepôt)

Le détail des activités et sites certifiés par norme est mentionné sur les certificats suivants :
The description of certified activities and locations per standard is mentioned on the following certificates:

Certificat ISO 9001 : 2015 n° 15510
Certificat ISO 14001 : 2015 n° 112366
Certificat ISO 45001 : 2018 n° 112367

Certificats ISO 9001, ISO 45001 et ISO 14001 délivrés sous accréditation n° 4-0001
Certificates ISO 9001, ISO 45001 and ISO 14001 issued under accreditation n°4-0001

Ce certificat est valable à compter du (année/mois/jour) *This certificate is valid from (year/month/day)* 2025-01-28 Jusqu'au *Until* 2028-01-27

Julien NIZRI
Directeur Général d'AFNOR Certification
Managing Director of AFNOR Certification

Flashez ce QR Code pour vérifier la validité du certificat

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SAS au capital de 18 187 000 € - 479 076 002 RCS Bobigny - www.afnor.org

Choice of decontamination solutions

FEVDI has a large range of decontamination product to remove labile or fixed contamination. The selection of the product depends on the type of material to be decontaminate, labile of fixed contamination, and constraint regarding the secondary waste (liquid effluent or solid waste).

Secondary waste	Labile contamination	Fixed contamination
Liquid effluent	ALCATUM® (Liquid/Foam) FEVDIRAD AL (Liquid/Foam/Gel) FEVDIRAD AC2 (Liquid/Gel) NUTRIUM (Liquid)	CERIMOUSS (Foam) FEVDIRAD OX1, OX5, OXE (Gel)
No liquid, solid waste	Wiping Towel FIXAPRO GNS54	ASPIGEL 100, 200, 400, 500 (Gel)

Foam decontamination

Foam decontamination

- **FOAM** such as ALCATUM®

  Foam decontamination for RPV, nuclear cavity, fuel pool and tubes, vessel in NPP.

- Principle: Remove via chemical process the contamination with a foam. All is simply rinsed by water.

- Suitable for ceiling, round shape object, holes, pipes….

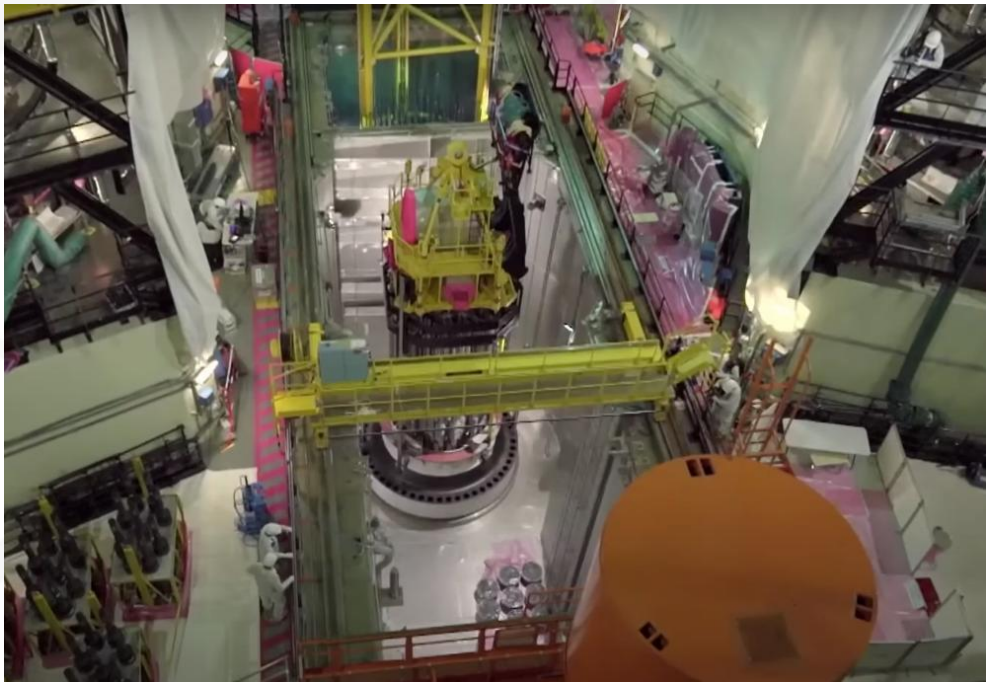
- Can be also used for dismantling activities

Foam decontamination

RPV cavity water is drained after load/unloading spent fuel and then need to decontaminated with foam

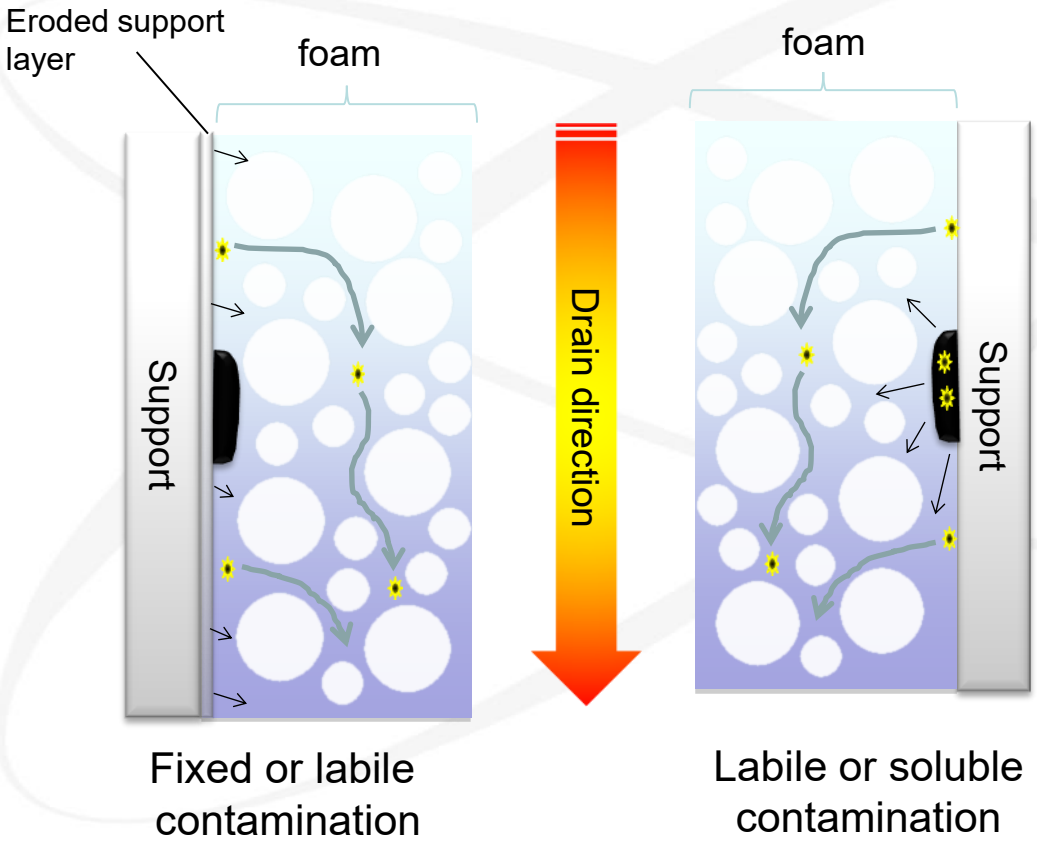
Advantages of foam compare to liquid:

- generate less liquid wastes
- retain the radioactive particles and drain them,
- fill a volume, as pipe, with little liquid,
- increase the time contact,
- improve the efficiency compared to a non-foaming liquid.



Foam process

- Actions of the foam during the decontamination



Legend

- Radioactive Particle
- Oily or greasy substance Or Boron crystals Or fixed contamination
- Motion (by drain, capillarity, gravity, etc.)
- Dissolution

Definition

- Labile : easy to move
- Fixed : attached at its support

Two types of foam decontamination

- Two types of foam decontamination application:
  - Foam decontamination degrease and dissolve
    - ALCATUM / FEVDIRAD AL Liquid or foam
  - Foam decontamination to remove fixed contamination by erosion
    - CERIMOUSS + FEVDIMOUSS

ALCATUM® 2

- **Characteristics**
  - pH 10,
  - density 1.000,
- **Decontaminating features**
  - degreaser,
  - removes thin film of acid boric,
  - removes labile particles.
- **Other features**
  - no salts or sequestering agent as EDTA (no chelating agent),
  - No irritating to the eyes.
  - low foaming,
  - do not leave marks,
  - biodegradable,
  - Used pure only.

- Usage (°C) : 15 – 50°C
- Storage (°C) : 10 – 30°C
- Cloud point (°C) : > 50°C

PMUC (Produits et Matériaux Utilisés en Centrale nucléaire)

PMUC is a label delivered by EDF for all chemicals substances used in NPP ensuring that no halogen and sulfuric elements are used.

According to the EDF D5710/IMC/1999/007111 regulation, all EDF and contractor on-site activities are governed by the “Material and Equipment for use in power plant” program (PMUC). The plant has the list of all chemicals and substances used in the facilities.
Each product has given a PMUC number.
The PMUC requires to have a concentration of Fluor, Sulphur, Chlorine, Bromide, Iodine lower than <10,0 mg/kg (10 ppm)
Free of Halogen

F (Fluor)
S (Sulfur)
Cl (Chlorine)
Br (Bromine)
I (Iodine)

ALCATUM® HO

- **Characteristics**
  - pH 11.2,
  - density 1.003,
  - only irritating to the eyes.
- **Decontaminating features**
  - degreaser,
  - removes thin film of acid boric,
  - removes labile particles.
- **Other features**
  - no salts or sequestering agent as EDTA (no chelating agent),
  - low foaming,
  - do not leave marks,
  - biodegradable,
  - Used pure only.

- Usage (°C) : 15 – 90°C
- Storage (°C) : 10 – 60°C
- Cloud point (°C) : > 90°C

Alkaline decontamination detergent for hot conditions application

Improvement of ALCATUM® 2

	ALCATUM	ALCATUM 2
PMUC number:	02-0065	02-1002
pH	11.3	9.5 – 10.5
Eyes irritant labelling		No labelling Non hazardous goods
Decontamination efficiency	Labile decontamination	Slighly improved (degreasing power inscreased)
Odor	Lemon odor	Lemon odor improved
Foaming capacity	Foaming through CAMUNI V5	Slightly increased (foaming capacity increased)

ALCATUM®

- Uses:
  - decontamination of the pool after the nuclear reactor fuel recharging,
  - decontamination of the nuclear fuel transfer system,
  - Other maintenance operations.

Example for pool decontamination

- FD : between 50 and 128,
- Common remaining specific activity : < 20 Bq/cm²
- Average time : 1 hour,
- Minimum number of operators : 2,

Foam equipment

LASER foam (10 for acid, 12 for basic)	Foam gun in stainless steel (24L and 50L)	CAMUNI V5
ALCATUM® FEVDIRAD AL MOUSSE CERIMOUSS/FEVDIMOUSS NEUTRE	ALCATUM® FEVDIRAD AL MOUSSE	ALCATUM® FEVDIRAD AL MOUSSE CERIMOUSS/FEVDIMOUSS NEUTRE
		
Surface area < 20 m²	**Surface area < 120 m²**	**Surface area > 120 m²**

Foam CAMUNI V5

- Generate foam : CAMUNI V5
  - Improving safety
    - No tank under pressure,
    - Resistant to basic, corrosive, acid or/and oxidizing
    - Holding tank of 42 L and dripping pan in technical compartment
    - Low pressure work (6 bar max.)
    - Compact and robust (Inox, composite material)
    - Self-sealing valve to avoid splashing risk
    - No transfer of products

Foam CAMUNI V5

ALCATUM® Video

Foam CAMUNI V5

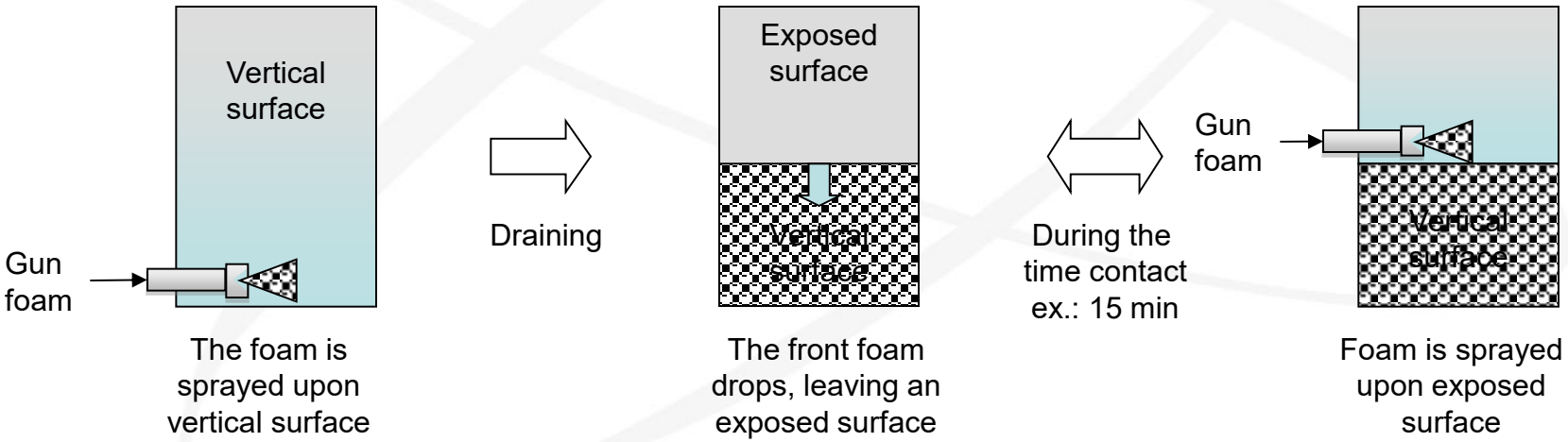
- Generate foam : CAMUNI V5
  - Practical
    - 2 devices in 1 : foam generator and low pressure water rinsing
    - 1 command for 4 features : foam, stop, rinse and purge (easy to use)
    - Fast loading and reloading of the product
    - Unlimited autonomy
    - Time saving against laser 10 and stainless steel gun foam
    - Mixing 50/50 of 2 products
    - Rinsing of the pump and pipes

- Need only low pressure compressed air supply
- Outlet with fast coupler compatible with all accessories of foam guns
- The foam can be carried from 8 to 50 m without modify its properties
- Possibility to do a foam train

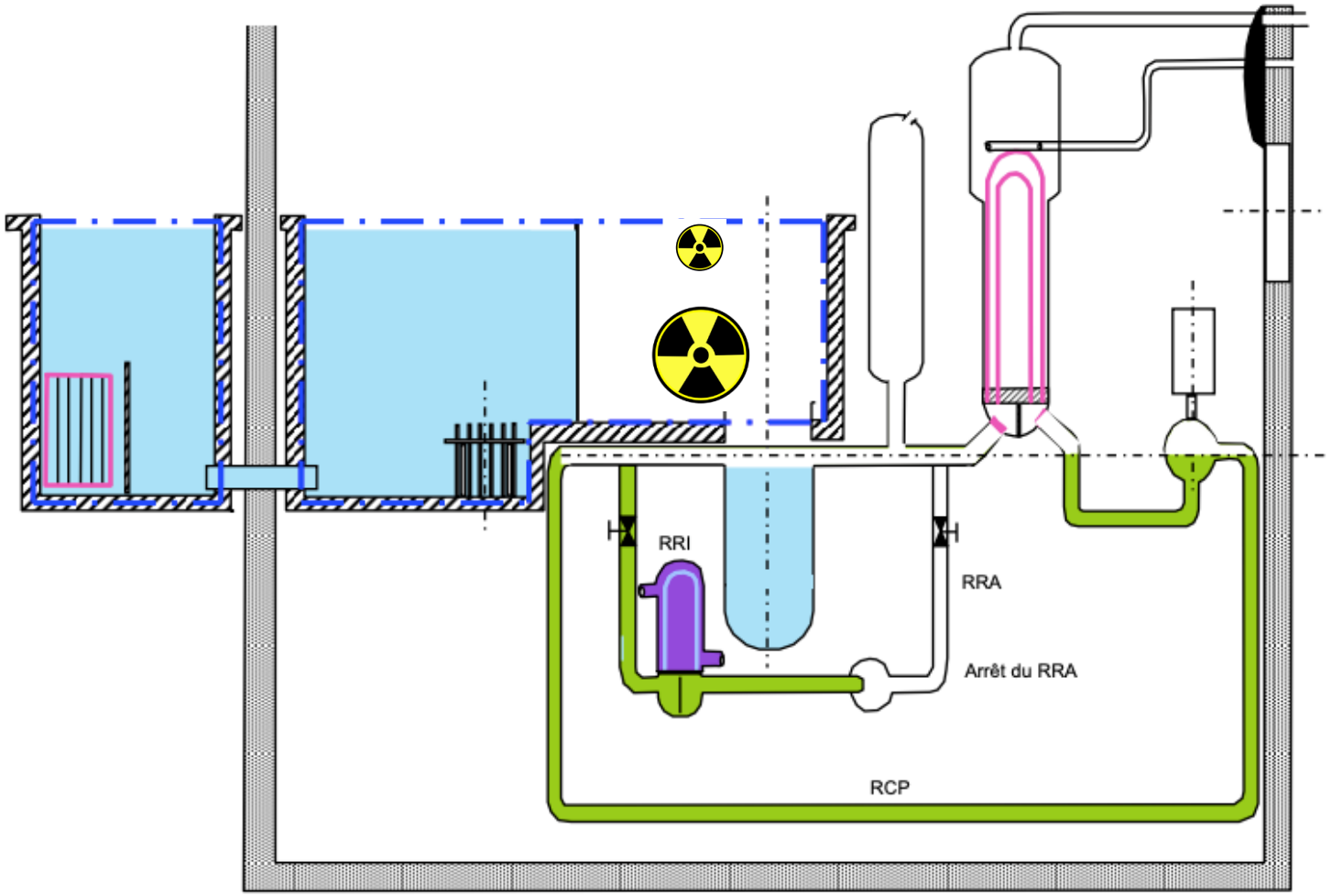
Foam process

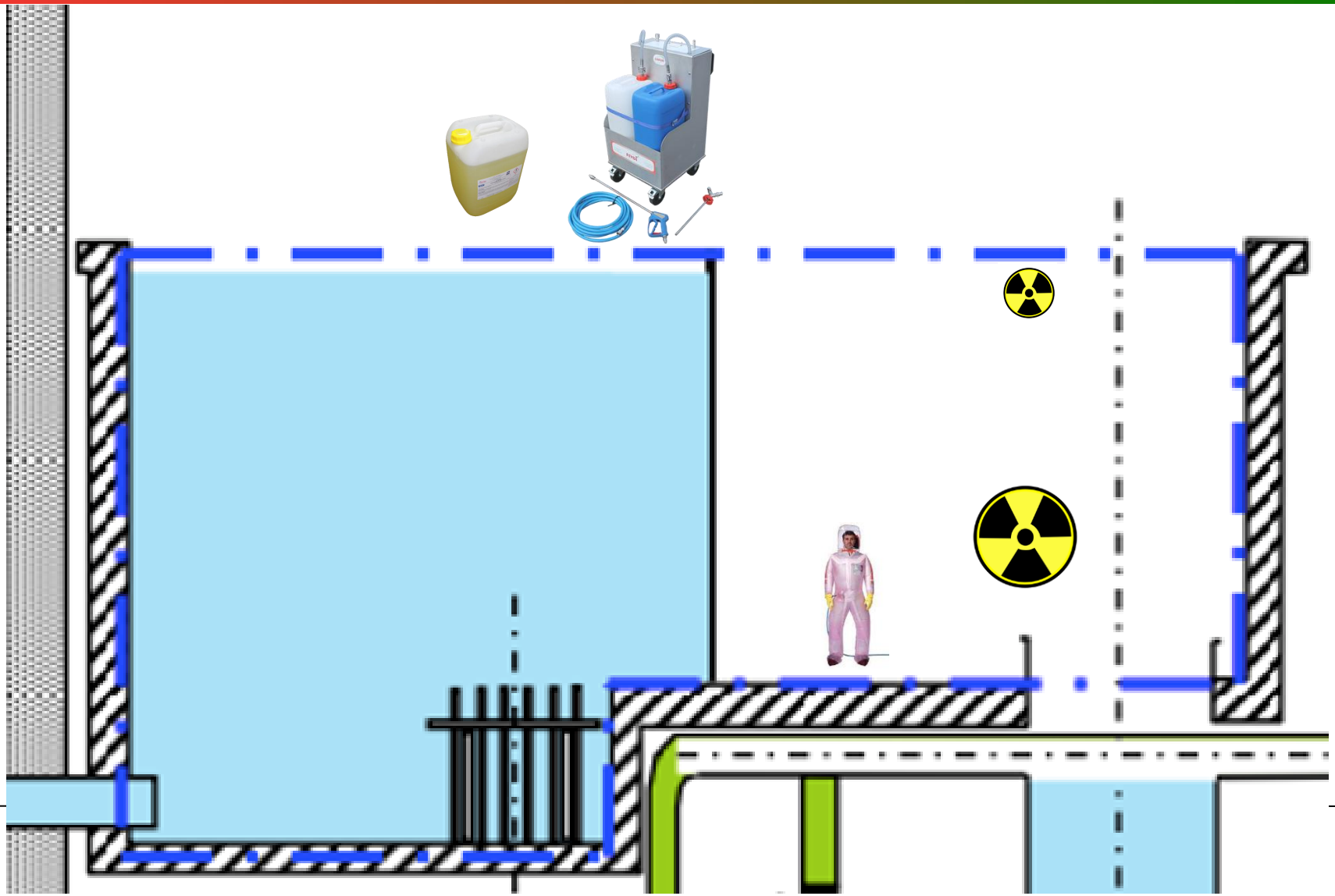
Time of contact (15 - 30 min recommended).

- stability of the foam : between 2 and 5 min,
- procedure to ensure the time contact upon vertical surface:



Nuclear reactor cavity decontamination





Case study

- Customer: EDF

Nuclear cavity decontamination from EDF Gravelines after fuel loading :

Number of technicians : 3 technicians

	Before decontamination	After decontamination
Average dose rate (mSv/h)	1,3	0,2 to 0,3
Max hot spot (mSv/h)	1,5 on the flanges	Hot spot removed

Activity	Duration	Number of staff	Dose received mSv
Application of ALCATUM foam	0h35	1	0,22
Rinsing with demineralized water	0h35	1	0,27
Dose measurement	0h30	1	0,05
Waste evacuation		1	0,38
		total	0,92

Case study

- Customer: EDF

Nuclear cavity decontamination from EDF Gravelines after fuel loading :

Duration of decontamination (foam, rinsing): 1h10
Total activity duration, decontamination, waiting time, dose measurement: 2h15
Real duration of the service: 4h00 (critical path at 8h)
Gamma characterization with wipe test on surface:

Chemical element	Before decon MBq/Kg	After decon MBq/Kg	Efficiency
Cr^{51}	248	2	99,19
Mn^{54}	19	0,2	98,95
Co^{58}	217	2	99,08
Co^{60}	97	1	98,97
Zr^{95}	51	0,4	99,22
Nb^{95}	72	0,6	99,17
Ag^{110}	10	0,2	98,00

FEVDIRAD AL MOUSSE (foam)

- Characteristics
  - pH > 13,
  - density 1.048,
  - Corrosive,
- Decontaminating features
  - degreaser,
  - remove crystal acid boric,
  - remove labile particles.
- Other features
  - no sequestering agent as EDTA,
  - very foaming,
  - easily removable,
  - Used pure or diluted (20% recommended).

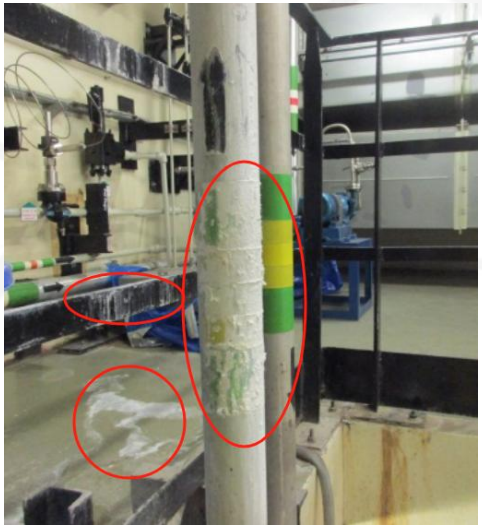
FEVDIRAD AL MOUSSE

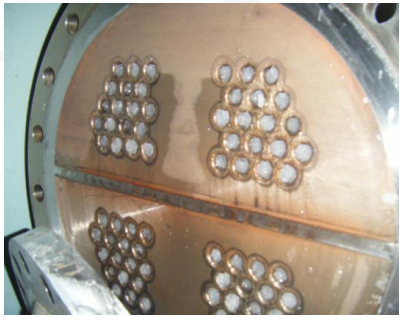
- Using
  - decontamination of the pool after the nuclear reactor discharging,
  - decontamination of the nuclear fuel transfer system,
  - Other maintenance operations.
- FD : about 100,
- Common remaining specific activity : < 20 Bq/cm²
- Average time : 1 day,
- Minimum number of operators : 2,

Cristallised Boron

- Cristallised Boron can happen in case of leakage of borated water,
- This can happen also in the case of decrease of temperature, this can block pipes.

• In a vessel, FEVDIRAD AL Liquid can be used to dissolve the crystallized bore.





• In blocked pipes, FEVDIRAD AL Liquid is used first to dissolve the solid parts, then FEVDIRAD AL foam shall be used to dissolve the residual parts.

• On wall, FEVDIRAD AL foam or gel are used.

Cristallised Boron

FEVDIRAD AL Video

Case study

- Customer: NUVIA

NUVIA case studies at EDF Dampierre NPP for crystallized boron:

- Pipe with around 1200 kg of crystalized boron with 10 000 to 20 000 Bcq.
- Application of 300 kg of **FEVDIRAD AL Liquid** in several pulverization as electric cable was passing through the tube; it is not possible to immerse with the liquid.
- After 2 to 3 hours, the boron is dissolved, and after rinsing only 10 to 20 Bcq were measured.
- The DF = 10 000, which was satisfying EDF.

Case study

- Customer: ONET

ONET case studies at EDF Cruas NPP for crystallized boron:

- Draining pipe with 30 cm of crystalized boron.
- Application of 2000L of FEVDIRAD AL Liquid with suction with membrane pump.
  After 1h30, all the boron was dissolved.

CERIMOUSS + FEVDIMOUSS NEUTRE

The combination of the CERIMOUSS + FEVDIMOUSSE NEUTRE through a dual foaming equipment such as CAMUNI V5 is used for nuclear decontamination by removing the fixed contamination.

Remove the oxide layer

0.3 µm (micron) can be removed on stainless steel 316L in 1 hour contact.

50% CERIMOUSS

50% FEVDIMOUSSE NEUTRE

FEVDIMOUSS / CERIMOUSS

CERIMOUSS

- Caracteristics
  - pH < 1,
  - density 1.39,
  - corrosive.
- Decontaminating features
  - erodes Inox,
  - removes fixed particles,
  - removes labile particles.
- Other features
  - contains Ce^{IV} but no NH_4^+,
  - non-foaming,
  - easily removable,
  - used pure or diluted.

FEVDIMOUSS NEUTRE

- Caracteristics
  - pH 7,
  - density 1.005,
  - not classified.
- Decontaminating features
  - degraeser,
  - remove labile particles.
- Other features
  - not contained salts and sequestering as EDTA,
  - very foaming,
  - easily removable,
  - used pure or diluted.

ADVANTAGES

Advantages of CERIMOUSS foam compare to liquid:

- Cost effective:
  - 1L produce 10L of foam which covers 10m^2
  - No need to rinse with high pressure water
  - generate less secondary liquid wastes (6 to 10 times less than liquid decontamination)
- Improve the efficiency compared to a non-foaming liquid
  - The foaming can retain on surface and fill a volume with complex shape
  - 1hour contact with stainless steel 316L can remove 0.3 µm
- Easy to use:
  - Foaming gun or CAMUNI for large surface
- Safe to use:
  - Free of ammonium
  - PMUC (no halogen)

Foam process

- Usual foaming products

Product	ALCATUM®	FEVDIRAD AL MOUSSE	CERIMOUSS	FEVDIMOUSS NEUTRE
pH	11,3 (alkali)	14 (very alkali)	0 (very acid)	7 (neutral)
Used for	Maintenance, like: - decontamination of the pool after the nuclear reactor discharging, - decontamination of the nuclear fuel transfer system, - Other maintenance operations. No dangerous good	Maintenance and decommissioning. Used upon very contaminated support and to remove the boron crystals. Corrosive	Maintenance and decommissioning, used in association 50/50 with FEVDIMOUSS for remove fixed contamination. Corrosive	Maintenance and decommissioning, used alone for slight decontamination or in association 50/50 with CERIMOUSS for remove fixed contamination. No dangerous good
DF	between 50 and 128	about 100	DF : about 150	DF : about 150
Common remaining specific activity	< 20 Bq/cm²	< 20 Bq/cm²	NA	NA

MULTIPOOL tools

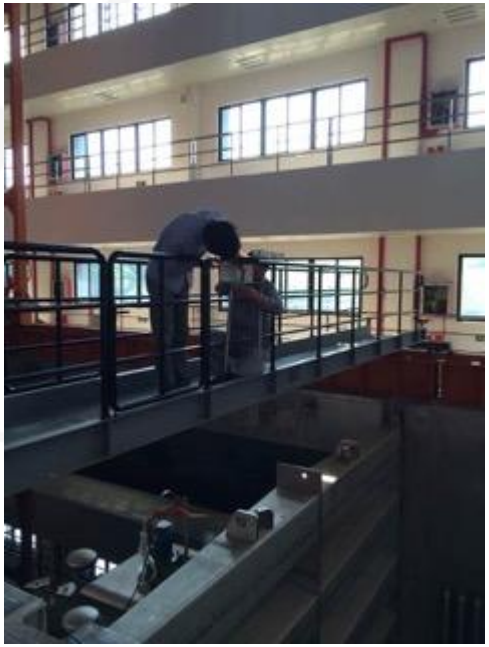
- **Foam spray tools**

For RVP pool decontamination, the ALCATUM® is used by the **MULTIPOOL tools**

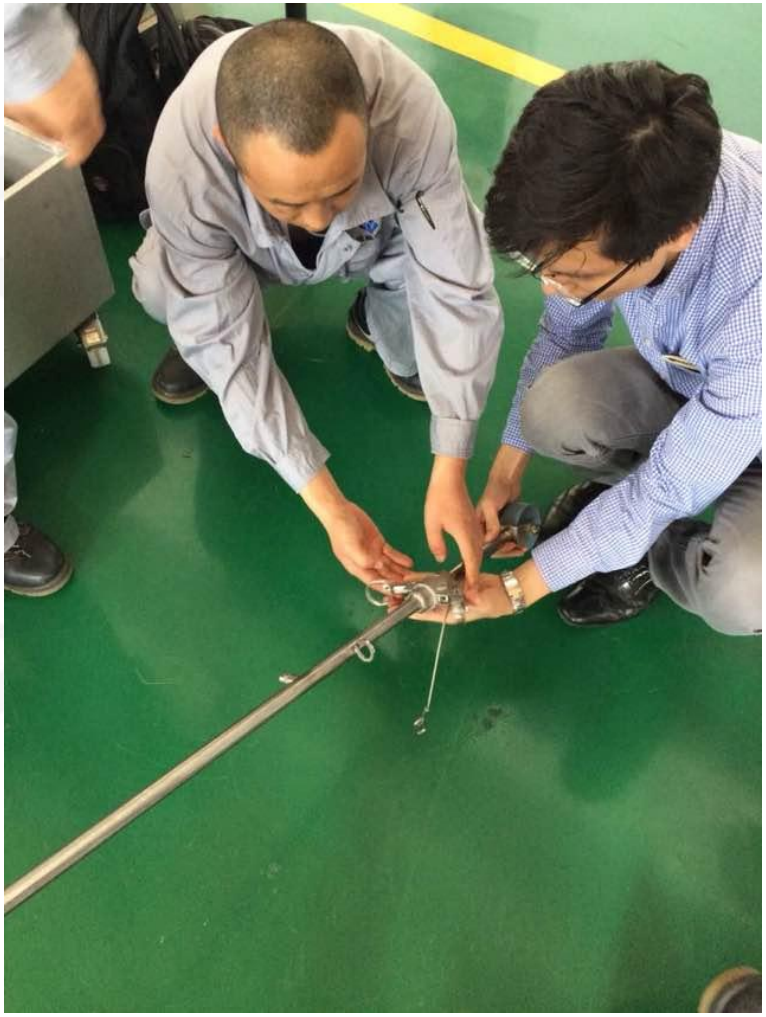
  - 12 tubes of 2 m,
  - 4 tools,
  - 1 hose of 5 m,
  - 1 hook for hanging,
  - 1 box for storage

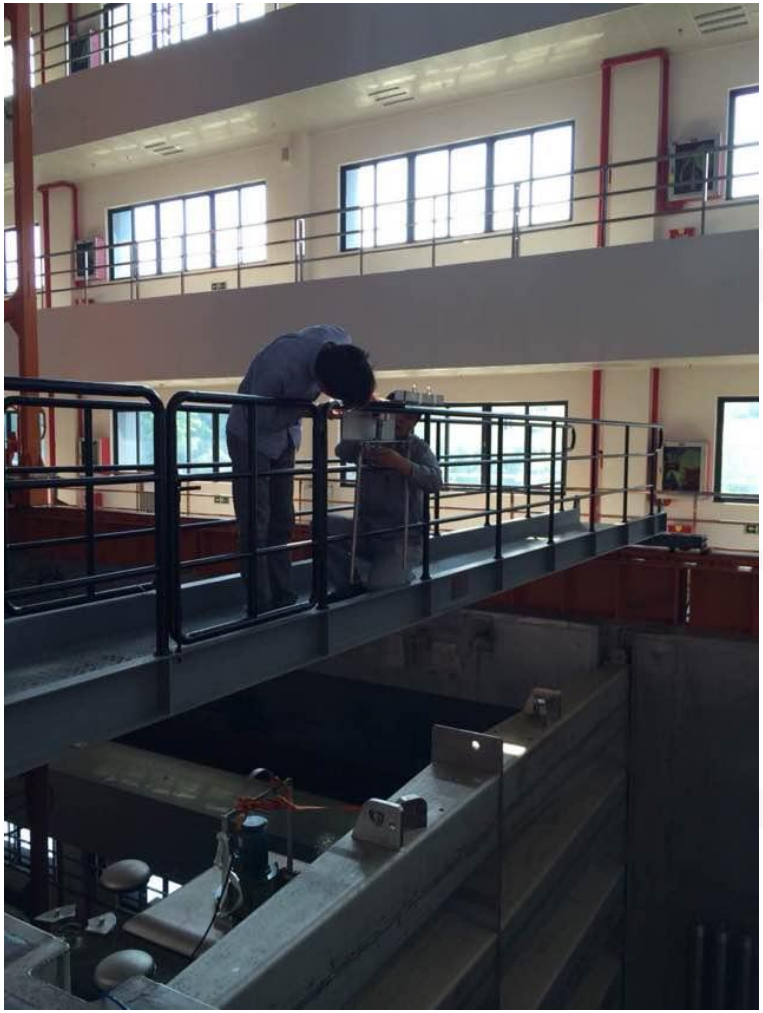
Training

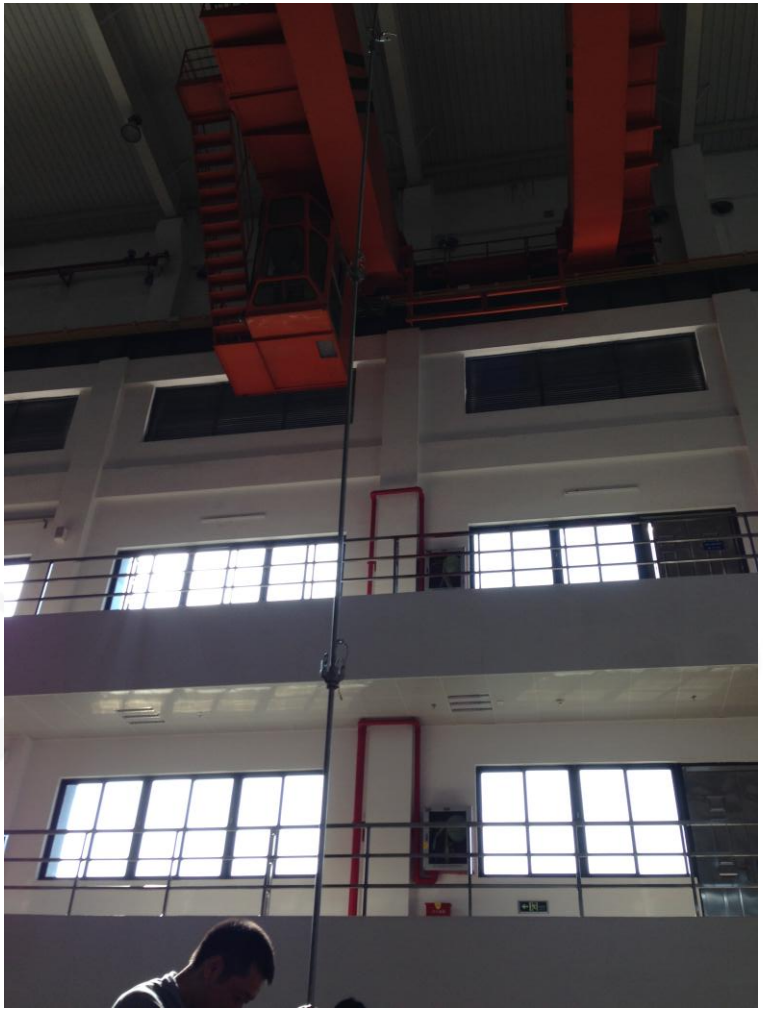
- FEVDI can ensure the training of the CAMUNI and MULTIPOOL tools in France CETIC training installation or at customer site.

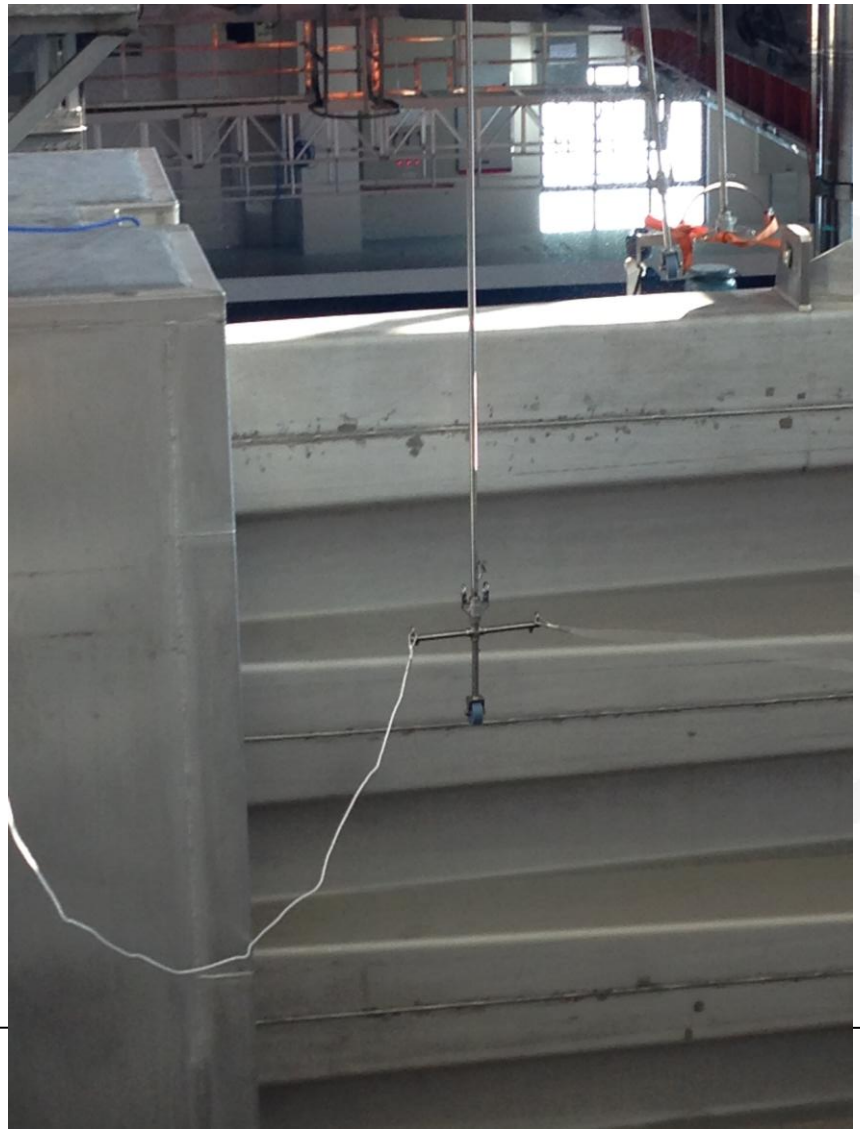


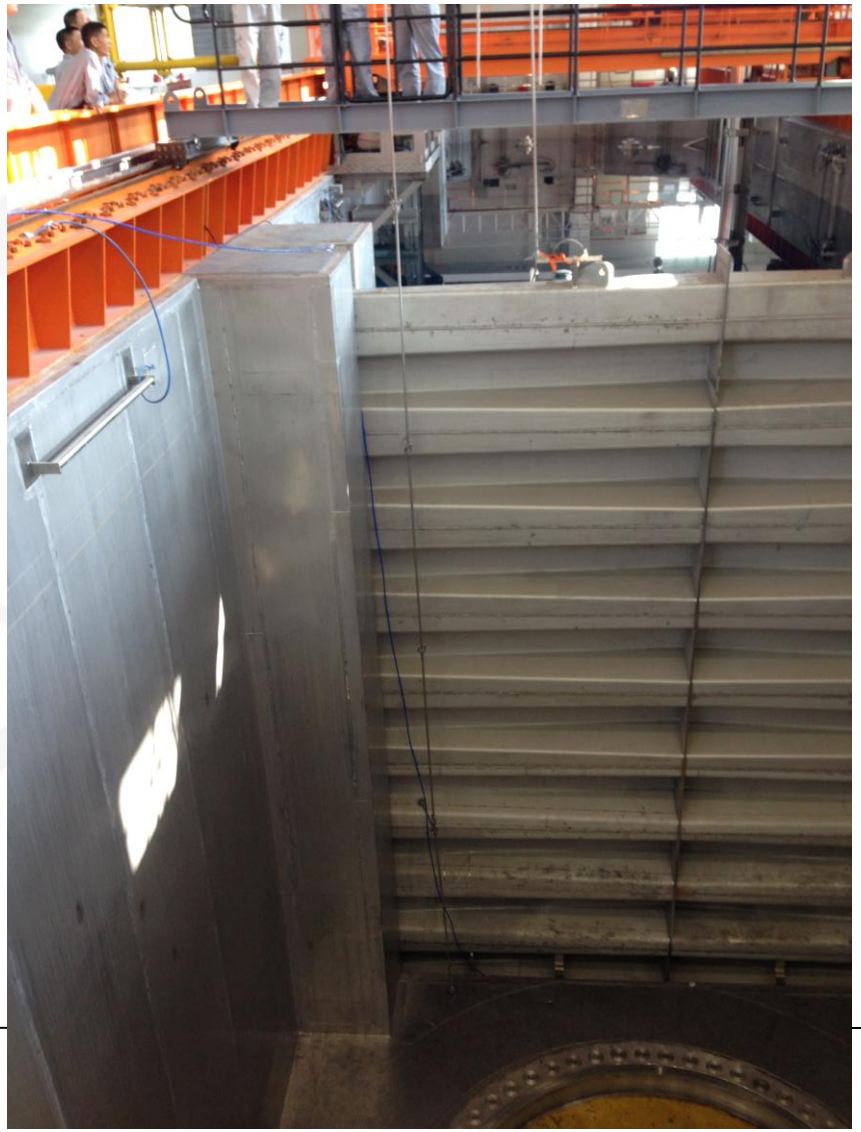
FEVDI 2014 Training of China CGN DayaBay staff, nuclear training center

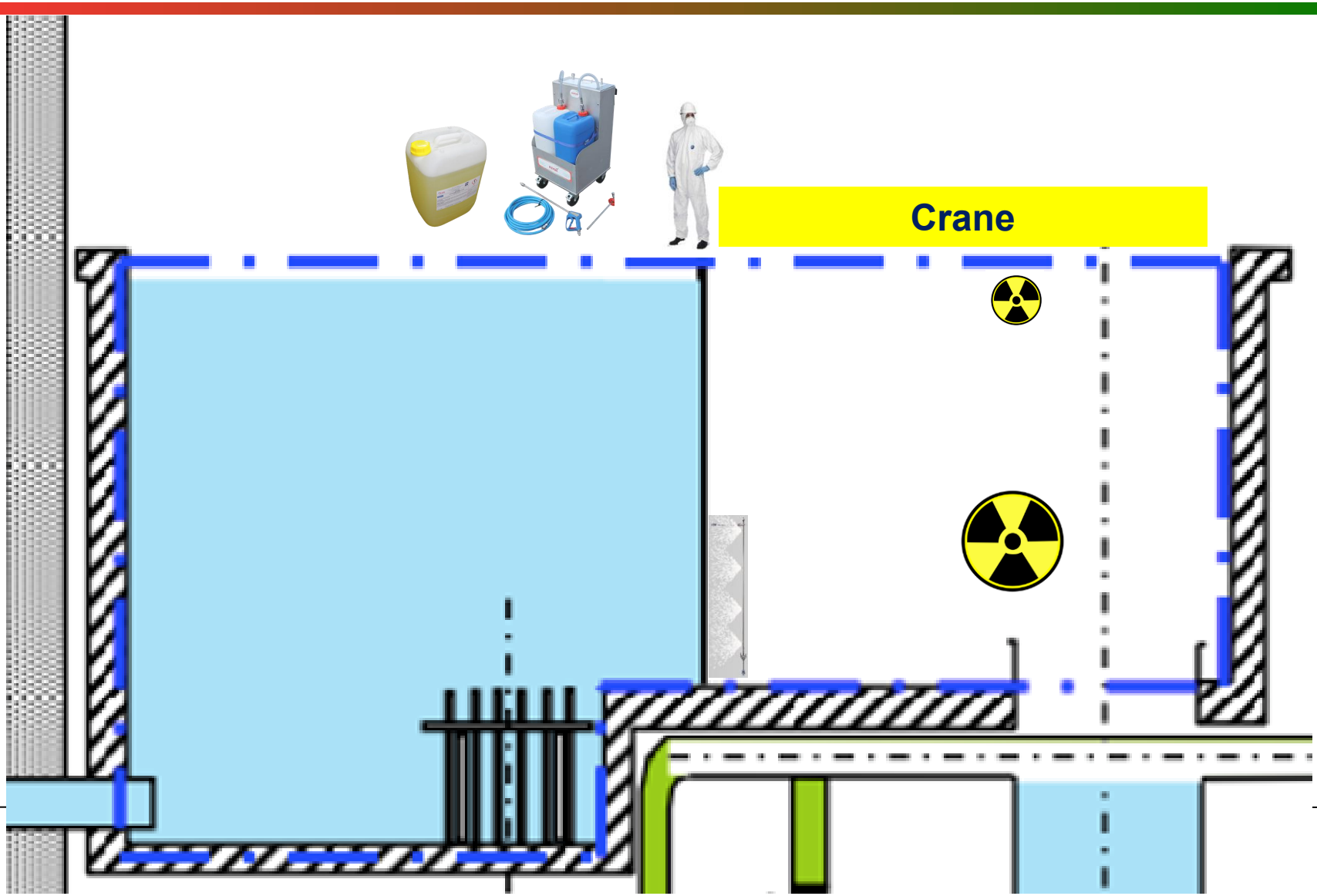











Crane

MULTIPOOL tools

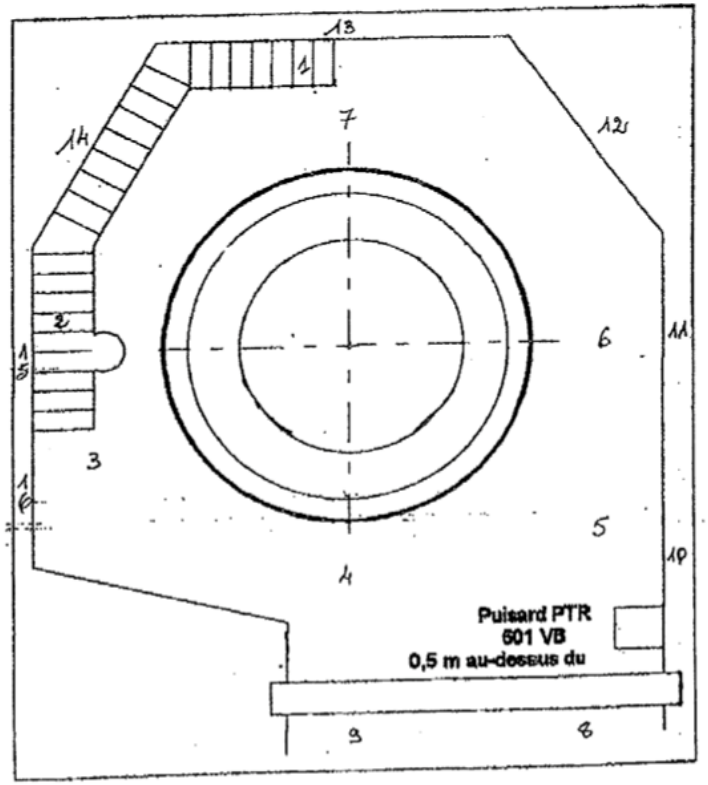
MULTIPOOL tools video

Case study

- Customer: EDF

Nuclear cavity decontamination from EDF Saint Laurent des Eaux:

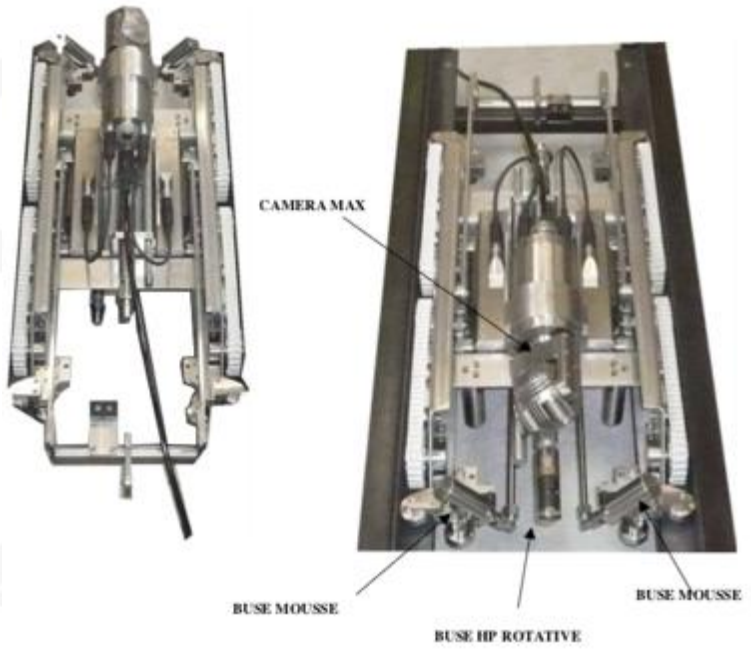
- Application of ALCATUM in foam with Multipool tool at 2 m height from the bottom
- Rinsing with low pressure water
- Same procedure for the floor

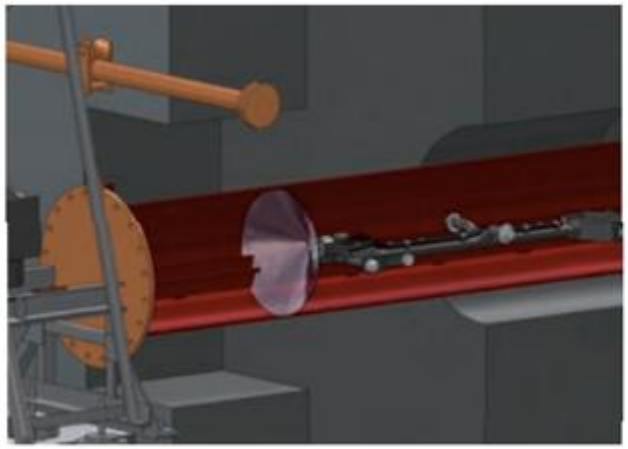


c/sec	Before decontamination	After Alcatum
1	>10000	16
2	>10000	14
3	>10000	260
4	>10000	16
5	>10000	17
6	>10000	10
7	>10000	11
8	>10000	20
9	>10000	10
10	>10000	3
11	200	130
12	1000	/
13	250	4
14	350	3
15	400	1
16	250	26

Decontamination of transfert tube

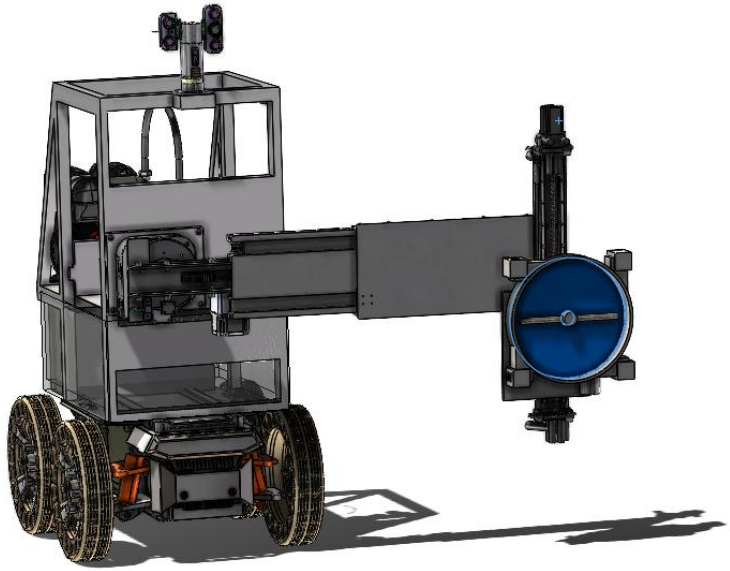
- FEVDI ALCATUM foam can be used to decontaminate the transfer tube between the RPV pool and the Spent fuel pool with a robot spraying foam.

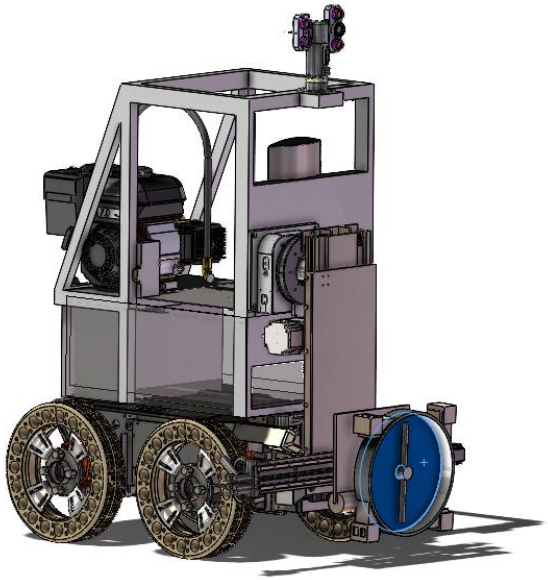




FEVDI FOAM-ROBOT

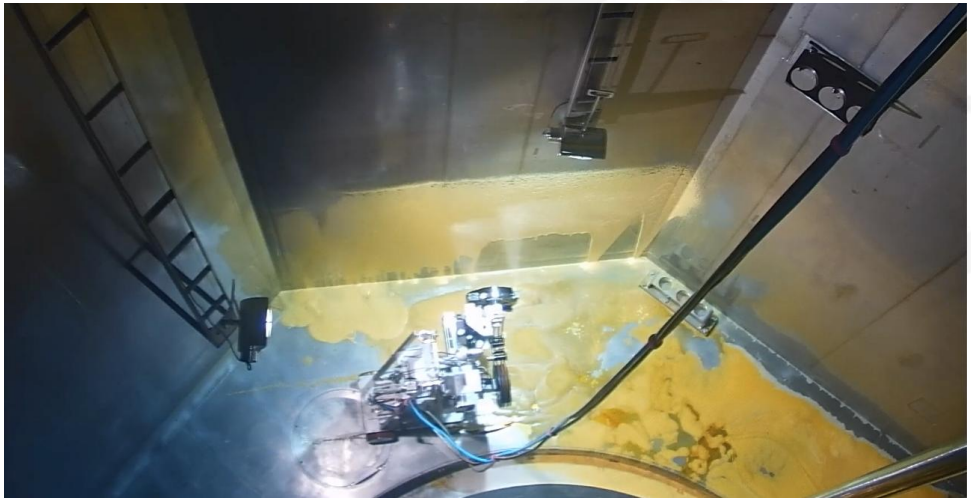
- FEVDI is working on a new robot to replace human for spraying nuclear decontamination foam



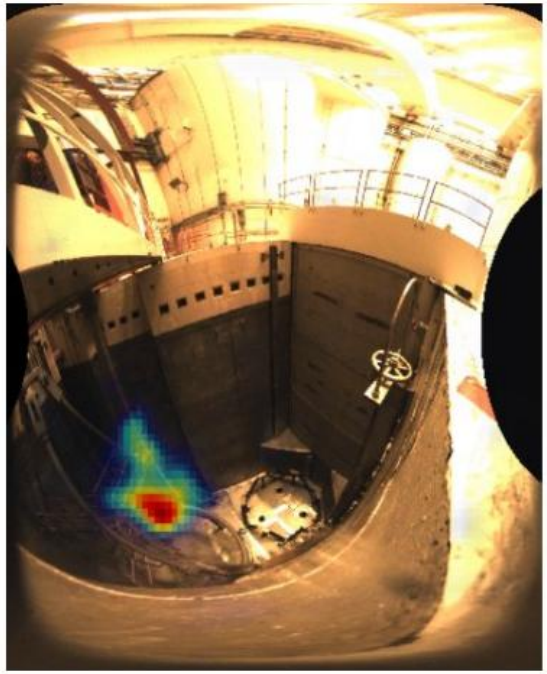


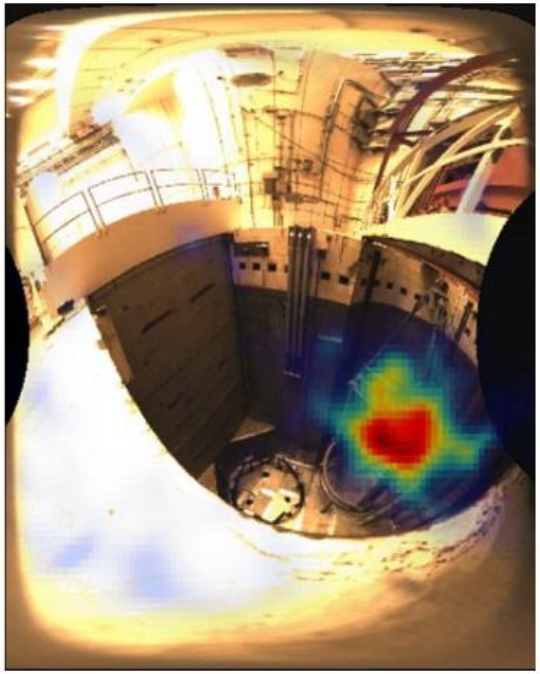
FEVDI FOAM-ROBOT

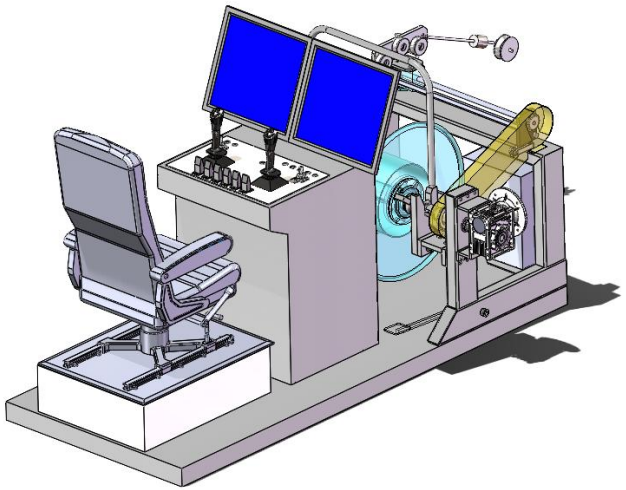
- FOAM-ROBOT can spray ALCATUM, FEVDIRAD AL and CERIMOUSS for nuclear cavity decontamination a with robotic solution

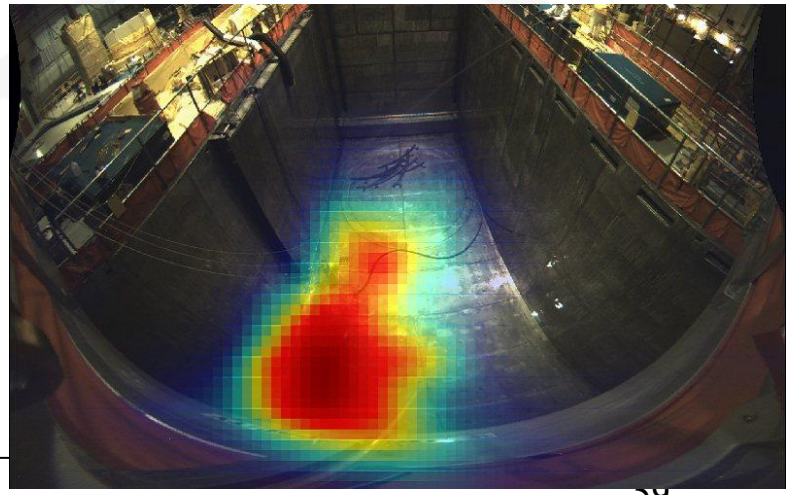


FEVDI FOAM-ROBOT



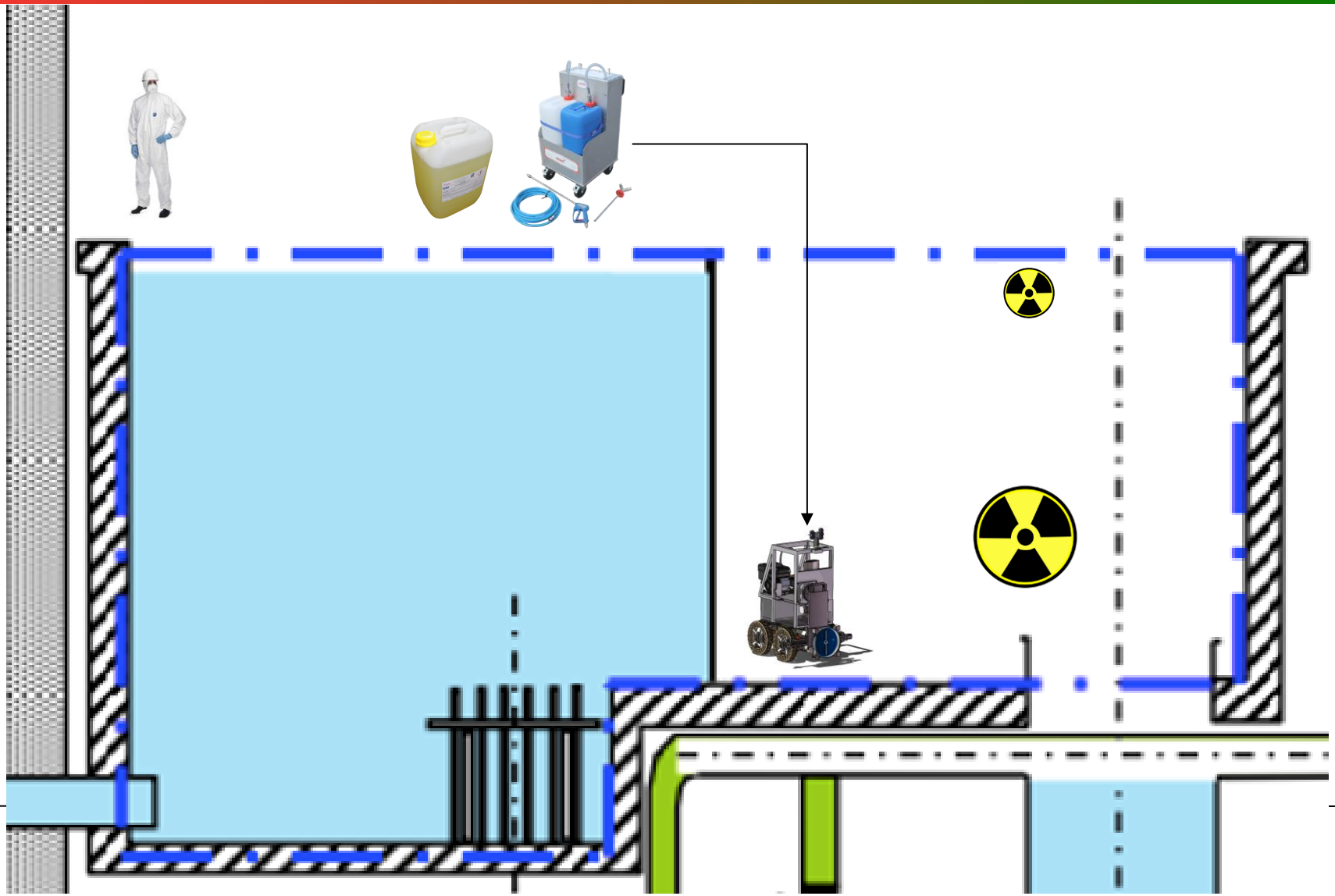






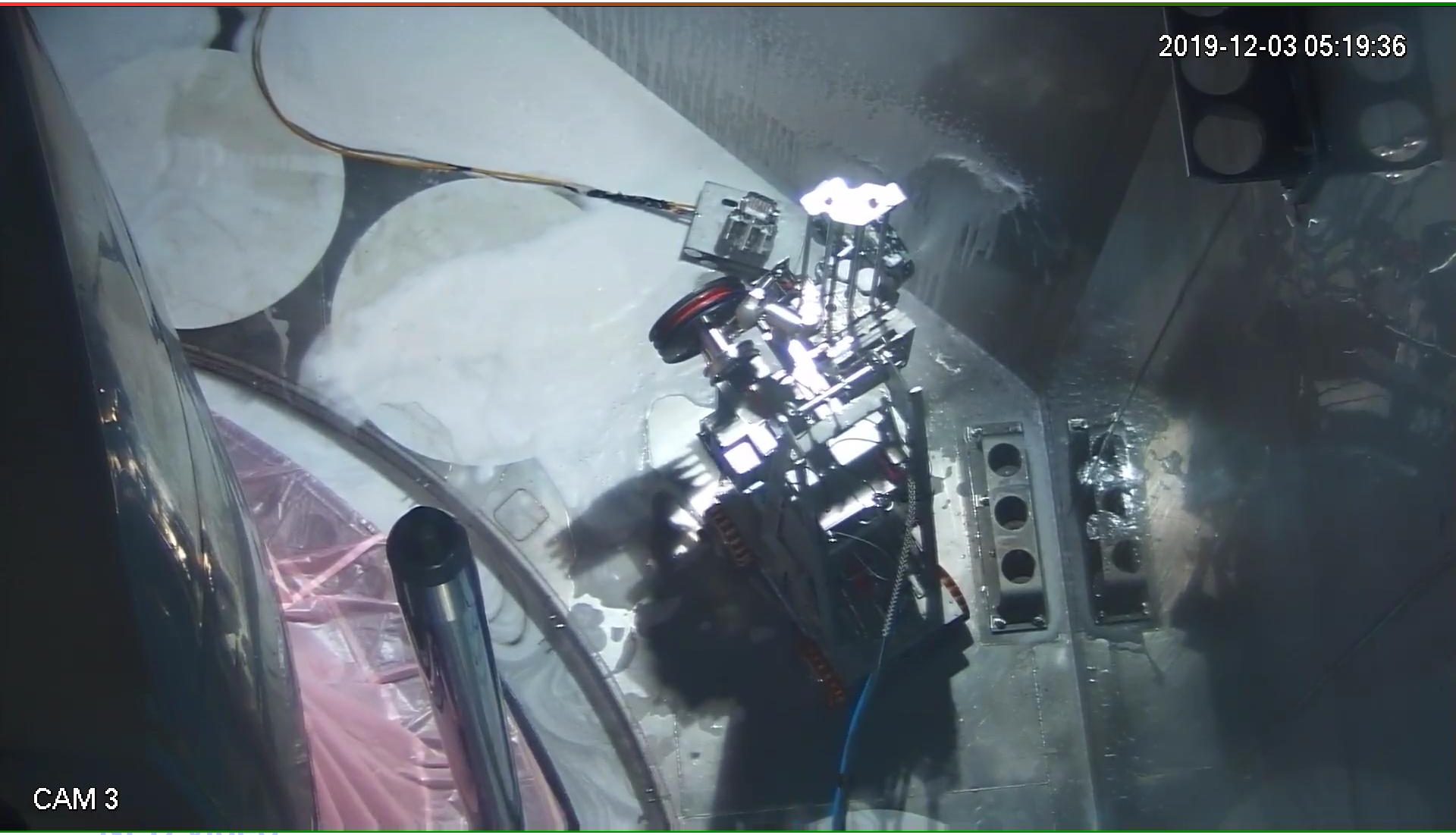
- Adding a gamma camera allows to measure in reality time the contamination and focus the decontamination foam on the most contaminated area.

FEVDI FOAM-ROBOT



- No risk of alpha contamination
- No dosimetry
- Better decontamination performance

FEVDI FOAM-ROBOT



ULTRASONIC BATH

ULTRASONIC BATH

FEVDIREM DNB can be also used as an alkaline decontaminating liquid in ultrasonic bath.

Being a non-foaming with a strong degreasing power.

Source: https://www.uatom.org/

GELIFOAM®

GELIFOAM® for decontamination

- **GELIFOAM®** is an innovative foam to decontaminate large space such as vessel, large tube, steam generator, pressurizer, pump, glove box, by filling with a static foam (long duration foam 4-5 hours).

- With foaming capacity up to 15, the liquid effluent is reduced while having the equivalent decontamination factor than liquid.

ADVANTAGES

Advantages of GELIFOAM® compare to liquid:

- Different type of foam formulation can be developed: removal of labile contamination or fixed contamination.

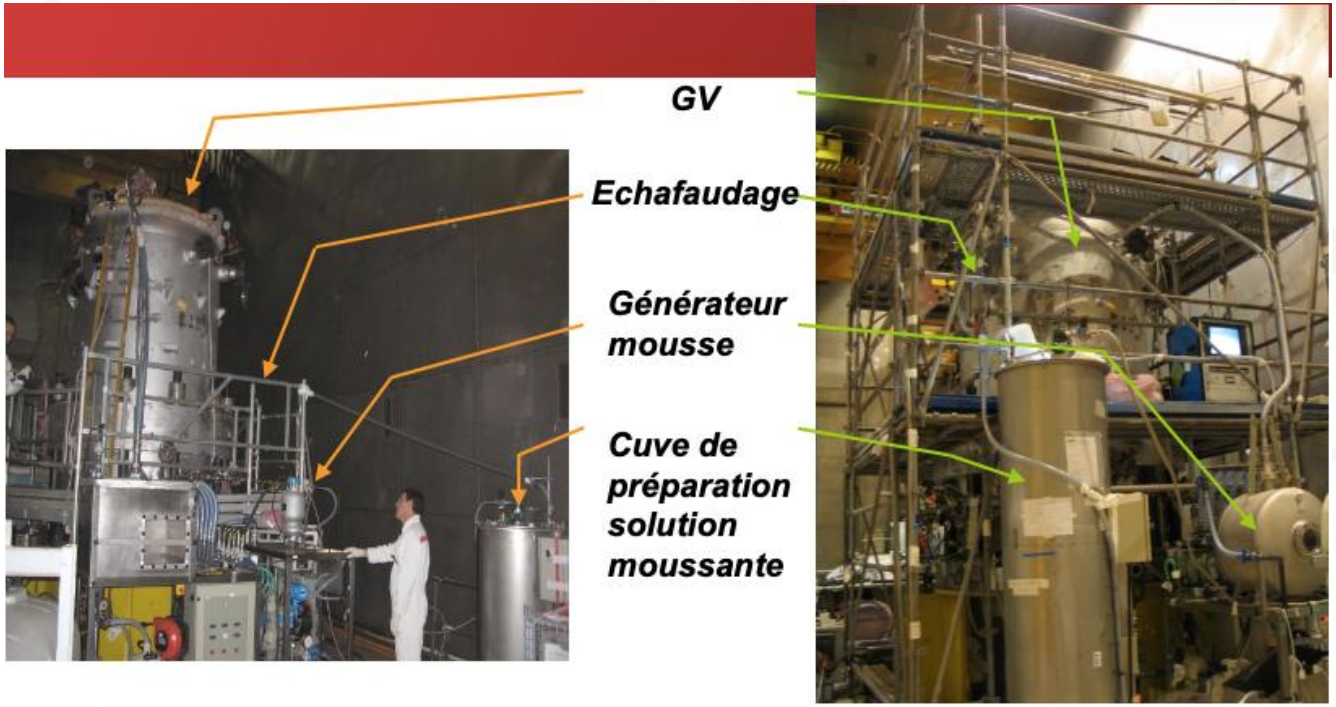
- Efficiency highly improved compare to normal foaming
  - The foam can be stabled for up to 5 hours which increase the contact time.

- Cost effective:
  - High foaming capacity up to 15
  - No need for water rinsing, thus a reduction of liquid effluent

- Easy to use:
  - GENEFOAM is a high flow rate for GELIFOAM® with a 100L/min
  - Effluent to be evacuate by using a simple pump
  - Used remotely with a foaming with 50 m away from the equipment to be decontaminated

Case study

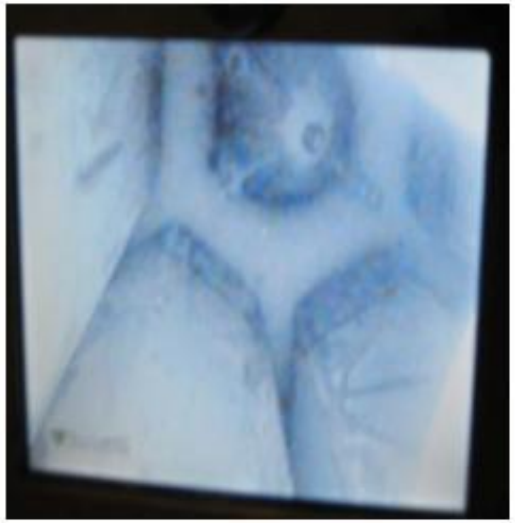
- Customer: CEA DCNS France
- Decontamination of heat exchanger secondary circuit tubes with GELIFOAM® for nuclear submarine

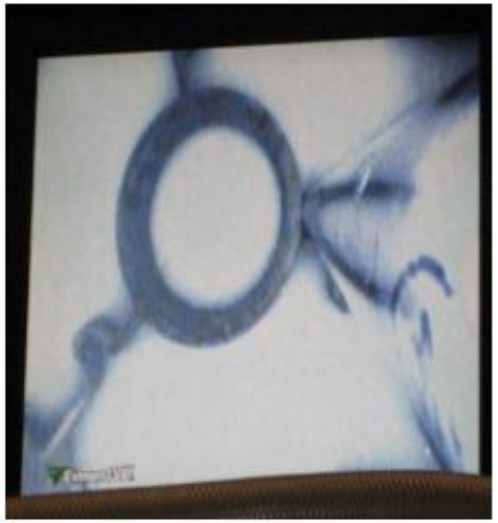


Photos from CEA

Case study

- Customer: CEA DCNS France
- Decontamination of heat exchanger secondary circuit tubes with GELIFOAM® for nuclear submarine



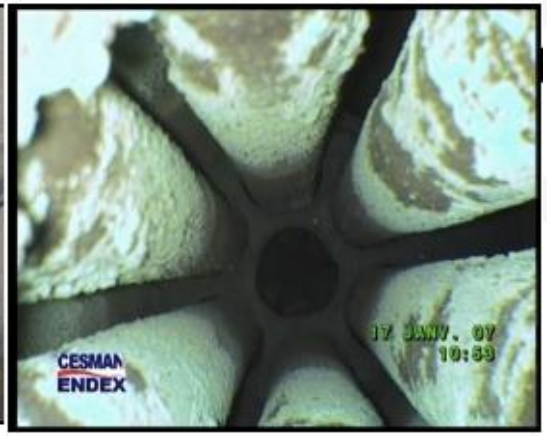


Inspection of the SG while filling with GELIFOAM®

Photos from CEA

Case study

- Customer: CEA DCNS France
- Decontamination of heat exchanger secondary circuit tubes with GELIFOAM® for nuclear submarine

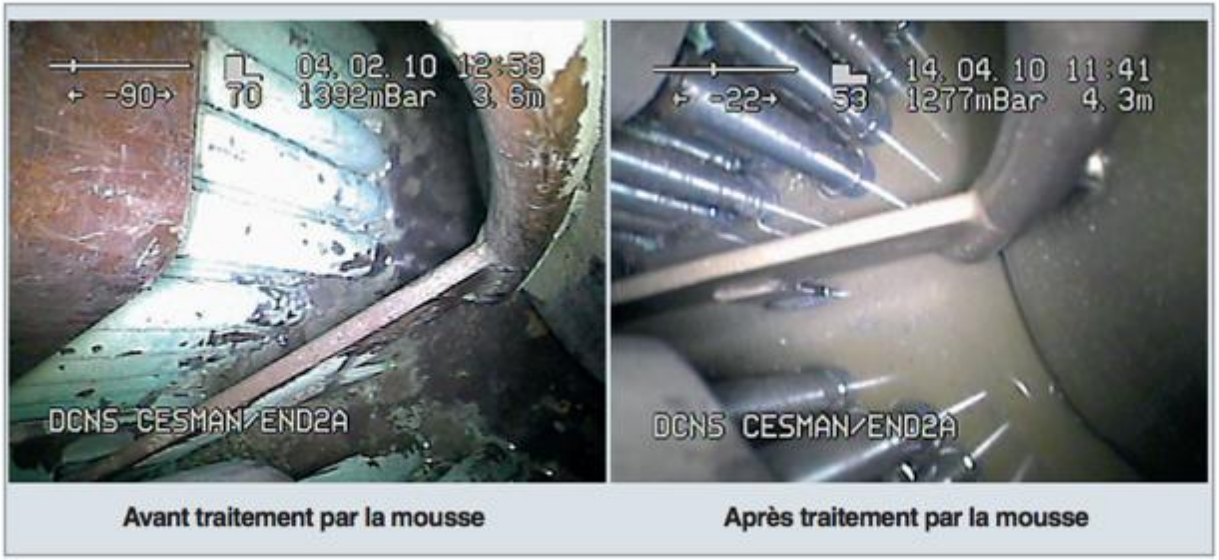


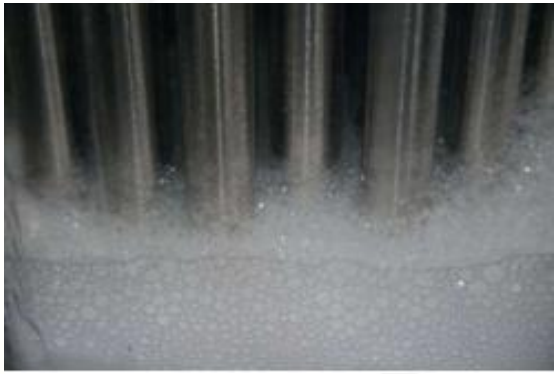
Photos from CEA

- Removal of sludge of a volume of 2m3 in different type of material (stainless steel + austenitic stainless steel).
- Reduction by 6 of effluent compare to standard SG decontamination (Westinghouse process)
- Removal of oxides dissolved by the foam.
- Formulation of the foam to removal oxides while avoiding further corrosion

Case study

- Customer: DCNS France
- Decontamination of steam generator secondary circuit tubes with formulated foam for maintenance





Before foam decontamination

After foam decontamination

Photos from CEA

Filling a 1m3 in 30 s

Wiping decontamination

Wiping process

- Format 32 x 40 cm
  - DNM4 towels impregnated with ALCATUM®,
  - ALCATUM®, Product PMUC n°02-065,
  - 48% polyester, 52% cellulose,
  - Not left traces after wiping,
  - Degreasing,
  - Remove labile particles like dust or labile contamination,
  - The zipper bag avoid ALCATUM® evaporation after opening,
  - With the FME approach, the orange bag is designed to be visible immersed in the water,
  - Designed for manual decontamination,
  - Period of validity : 2 years.

cartons of 15 orange zipper bag of 20 ALCATUM® impregnated towelettes

Palette : 24 cartons

Wiping process

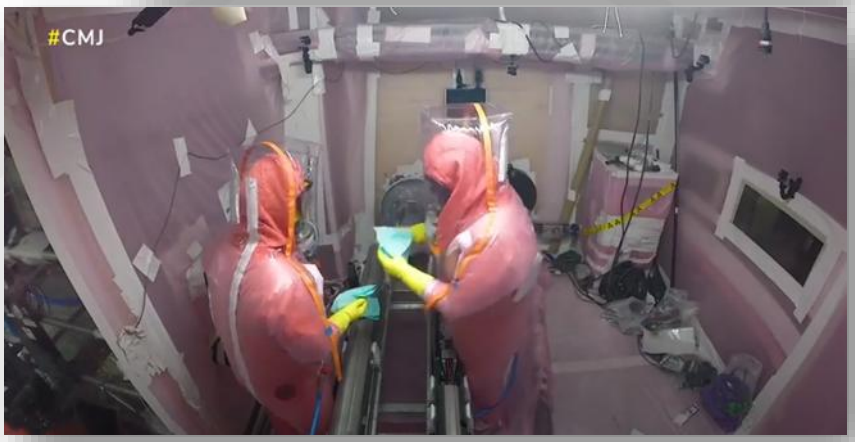
- Format 32 x 40 cm
  - **Microfiber** towels impregnated with ALCATUM®,
  - ALCATUM®, Product PMUC n°02-065,
  - **Free of cellulose 70% polyester, 30% polyamide, nitric acid approved**
  - Not left traces after wiping,
  - Degreasing,
  - Remove labile particles like dust or labile contamination,
  - The zipper bag avoid ALCATUM® evaporation after opening,
  - With the FME approach, the orange bag is designed to be visible immersed in the water,
  - Designed for manual decontamination,
  - Period of validity : 2 years.

cartons of 15 orange zipper bag of 20 ALCATUM® impregnated towels (MICROFIBERS)

Palette : 24 cartons

Wiping process

- Used by ORANO during decommissioning activities



Wiping process

Decontamination towels are used for decontamination during maintenance:

- Maintenance of nuclear power plant
- Decontamination of dummy head of nuclear reactor.

Wiping process

Decontamination of dismantling parts with ALCATUM Towels at ORANO La Hague:

- Decontamination of a cutting disk

Source:
https://www.youtube.com/watch?v=eT7xndzNoJE&ab_channel=100%25Docs-Crime

Wiping process

- Format 32 x 60 cm
  - DNM4 towels impregnated with ALCATUM®,
  - ALCATUM®, Product PMUC n°02-065,
  - Not left traces after wiping,
  - Degreasing,
  - Remove labile particles like dust or labile contamination,
  - The zipper bag avoid ALCATUM® evaporation after opening,
  - With the FME approach, the orange bag is designed to be visible immersed in the water,
  - Initially Designed to clean floors,
  - Period of validity : 2 years.

carton of 6 orange zipper bag of 25 ALCATUM® impregnated towelettes

Palette : 18 cartons

Wiping process

- ROULSO 60F
  - Pre-cut format 32 x 27 cm of 60 DNM4 towels Impregnated with ALCATUM®, PMUC n°02-065,
  - Not left traces after wiping,
  - Degreasing,
  - Remove labile particles like dusts or labile contaminations,
  - Lid with a dispensing cruciform hole and a fixed sealed plug,
  - Refillable pails with ALCATUM® impregnated roll of 60 format 32 x 27 cm,
  - Period of validity : 2 years.

cartons of 4 pails of 60 ALCATUM® impregnated towelettes

Palette : 72 pails

Wiping process

- ROULSO 60F
  - Pre-cut format 32 x 27 cm of 60 DNM4 towels Impregnated with ALCATUM®, PMUC n°02-065,
  - Not left traces after wiping,
  - Degreasing,
  - Remove labile particles like dusts or labile contaminations,
  - Lid with a dispensing cruciform hole and a fixed sealed plug,
  - Refillable pails with ALCATUM® impregnated roll of 60 format 32 x 27 cm,
  - Period of validity : 2 years.

Wiping process

Video ALCATOM impregnated towels

Tent decontamination

Wiping process

- The white towels 100% Viscoses:
  - Non-woven towel,
  - White color,
  - Lint free,
  - Very soft,
  - 100% hydrophilic polyester,
  - No chlorate treatment
  - Excellent resistance to tearing,
  - Absorption capacity of 68 g of demineralized water by towel,
  - The dusts are fixed by the fiber of the towel,
  - **Nitric acid proof, mostly used in fuel reprocessing activities**

Carton of 10 sealed bag of 50 serviettes

Palette : 18 cartons

The two sides are the same

Anti dust removal towel

Anti dust removal towel is a towel slightly impregnated with a resin to remove and keep the dust.

No halogen

Composition : 50% viscose and 50% polyester

Anti dust removal towel

Conditionning:

Box : 10 bags
Bags : 50 towels

Shower towels

- **Shower towels:**

Shower towels are used after shower of technicians after being expose in a nuclear environment.

- 70% cellulose and 30% Polypropylene
- 68 grs/m2
- White
- Absorption: 8 times its own weight in 6 seconds.
- Box 100 units of 75x112 cm

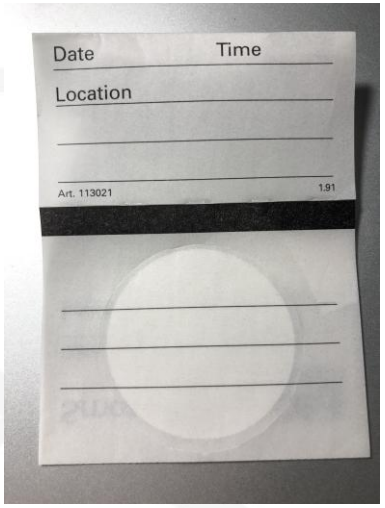
Test swabs

- **Test swabs :**

A smear test control that wipes out potentially contaminated. After sampling, the test swab is analyzed in a measuring device.

The self-adhesive test swabs are designed to absorb contamination from dry or wet surface.

- 100% cotton fabric, white
- Diameter of 44mm, self adhesive
- Dispenser box of 1000 pcs



Decontamination towels

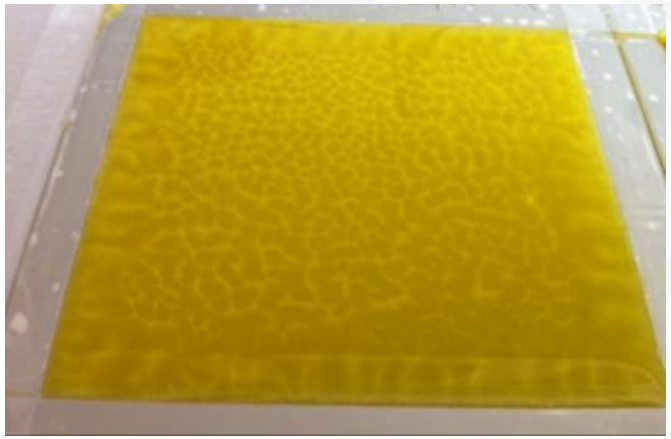
Item	Impregnated / dry	Towel
ALCATUM Towel 32x40 cm	ALCATUM impregnated	Blue towel 48% polyester, 52% cellulose
ALCATUM Towel 32x60 cm	ALCATUM impregnated	Blue towel 48% polyester, 52% cellulose
ALCATUM Microfiber Towel 32x40 cm	ALCATUM impregnated	100% Microfibers
ROULSO 60F 32x27	ALCATUM impregnated	Blue towel 48% polyester, 52% cellulose
ROULGA 60F (refill)	ALCATUM impregnated	Blue towel 48% polyester, 52% cellulose
ROULSO 80MF 32x27	ALCATUM impregnated	100% Microfibers
ROULGA 80MF (refill)	ALCATUM impregnated	100% Microfibers
100% viscose white towel	Dry	100% Viscose
Shower towel	Dry	70% cellulose and 30% Polypropylene
Anti-dust removal	Resin impregnated	50% viscose, 50% polyester

Washable gel Decontamination (High efficiency gel for FREE RELEASE)

Washable gel process

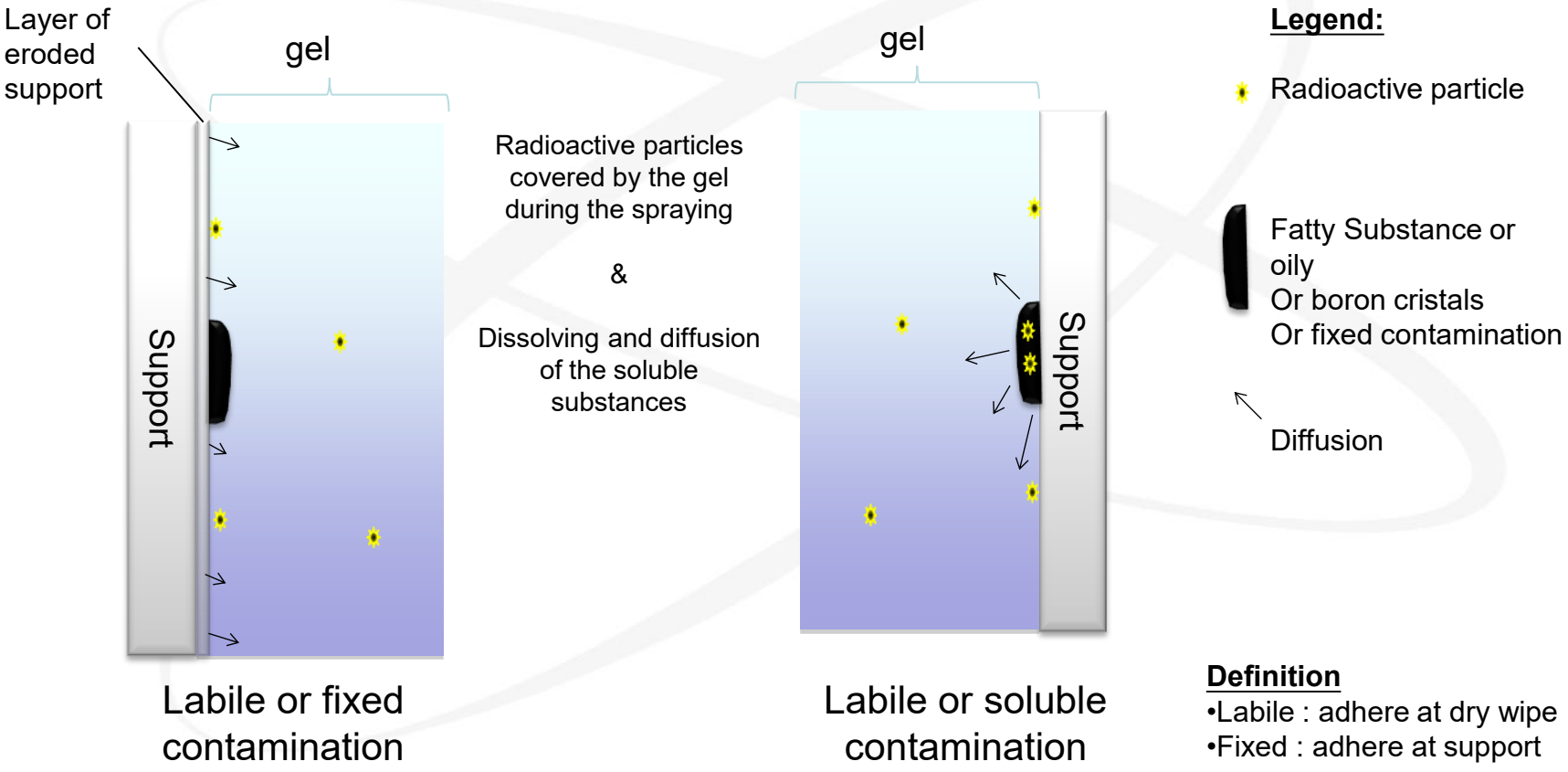
General procedure: Cerium IV Ce

- The gel is sprayed upon the support,
- The gel is left upon support until 1h30,
- The gel is rinsed with demineralized water,
- The volume of liquid waste is reduced by evaporation.



Washable gel process

- Actions of the gel during the decontamination



FEVDIRAD range

- The gels for nuclear decontamination with rinse

Version	Function	Time of contact	Nature of the support	Contamination type (Evalued DF)
FEVDIRAD AL GEL	Degreasing agent	1h30	All except aluminum alloys	Labile (150)
FEVDIRAD OX1 GEL	Oxidizing agent (erosion < 1 µm)	1h30	Stainless steel, Inconel	Labile and fixed (200)
FEVDIRAD OX5 GEL	Oxidizing agent (erosion ≈ 1 µm)	1h30	Stainless steel, Inconel	Labile and fixed (240)
FEVDIRAD OXE GEL	Oxidizing agent (erosion > 1 µm)	1h30	Stainless steel, Inconel	Labile and fixed (250)
FEVDIRAD AC2 GEL	Passivation of stainless steel	0h30	Stainless steel	Labile (100)

- Specific quantity of flushing water : 10 to 100 liter/m²

Washable gel process

- The most used washable gel:

Product	FEVDIRAD AL GEL	FEVDIRAD OX1 GEL	FEVDIRAD AC2 GEL
pH	14 (very alkali)	0 (very acid)	0 (very acid)
Used for	Maintenance and decommissioning. Used against labile contamination and to remove the thin layer of boron crystals. Used before FEVDIRAD OX1 GEL in order to remove the fatty layer.	Maintenance and decommissioning. Used against fixed contamination. Able to erode 0,8 µm of stainless steel in a single pass.	Maintenance and decommissioning. Used to remove the rust and passive the stainless steel.
DF	between 200 and 600	between 200 and 800	NA
Common remaining specific activity	< 3 Bq/cm²	< 3 Bq/cm²	NA

Washable gel process

- Devices to spray the gels:

Membranes pump.

Security valve.

Air pressure inlet with pressure regulator, manometer, beat reduction.

30 L or 60 L open head drum.

Spay gun with extension in order to be far away the radioactive source.

10 m hose.

Handling Cart for 60 L drum in option

ADVANTAGES

Advantages of FEVDIRAD GEL compare to foam:

- Very high efficiency:
  - Used for FREE RELEASE for metallic parts (<100Bq/kg)
  - High DF (Decontamination Factor): 250
- Improve the efficiency compared to a foaming
  - 1h30 contact with stainless steel 316L can remove 1.0 µm
- Easy to use:
  - Membrane pump

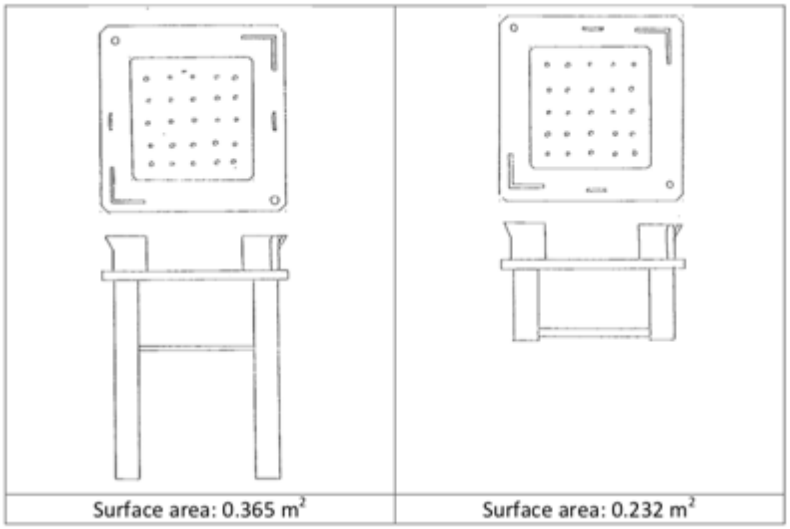
Case study

- Customer: TECNUBEL Belgium
- TECNUBEL uses the FEVDIRAD OX5 GEL to decontamination the equipment from the NPP for “free release” and to recycle it.
- Decontamination of “chair support”: The “chairs” are divided into two sizes: large and small size
- TECNUBEL has compared different technology:
  - Citrox + UT bath,
  - Grinding + UT bath,
  - Coldjet + Spongejet,
  - FEVDIRAD OX5 GEL.

TECNUBEL concludes that the FEVDIRAD OX5 GEL was the most efficient technology while easy to be implemented.

Case study

- Among 55 number of “chair”, 52 units were decontaminated by the FEVDIRAD OXE Gel. The decontamination factor is from 3 to 979. The average decontamination factor is 724,25.
- The “chairs” are numbered from 1 to 52. “,” is for small size chairs.
- The contamination decreased under a limit value allowing the equipment to be recycled as industrial waste. <100 Bq/kg



The surface decontaminated is: 28.43 m^2
Weight of gel used: 60 kg
Total consumption: 2,075 kg/m^2
Real consumption (estimated): 1 kg/m^2
Loss < 50%

Case study

- Customer: PreussenElektra Germany
- FEVDIRAD OXE Gel has been applied to decontaminate a primary pump wheel.
- Stainless steel 1.4313 (X3CrNiMo13-4; about AISI 415)
- Start with 1mSv/h, reduce to 0.5 mSv/h
- 100 kBq/l of Co-60 measured after rinsing.

Case study

- Customer: ONET France
- ONET uses the FEVDIRAD OX1 and OX5 in liquid version to test the removal of stainless steel layer in the perspective to remove fixed contamination for stainless steel 316L parts decontamination.
- Plates of stainless is used in a bath immerged with FEVDIRAD OX1 and OX5 liquid.

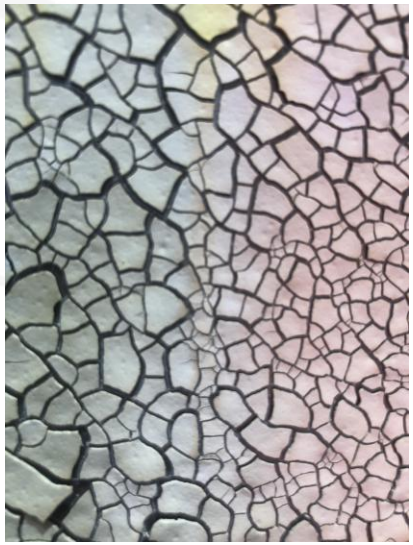
Plaque n°	Produit testé	t = 2h	t = 5h	t = 7h	t = 12h	t = 24,6h
1	FEVDIRAD OX1 LIQUIDE	1,77 ± 0,07	7,8 ± 0,2	13,3 ± 0,4	31,4 ± 0,9	58 ± 2
2	FEVDIRAD OX5 LIQUIDE	2,28 ± 0,09	10,2 ± 0,3	17,1 ± 0,5	39 ± 1	72 ± 2

- With the FEVDIRAD OX5 liquid, after 24h, 72 um is removed on each face of the stainless steel plate.
- ONET concludes that the FEVDIRAD OX5 Liquid was twice most efficient than nitric acid liquid.

Decontamination without secondary liquid waste with ASPIGEL® self-drying gels

Decommissioning application

- Decontamination with ASPIGEL (Self drying) => no liquid waste (Patent CEA – ORANO DEM).



ASPIGEL® demonstration

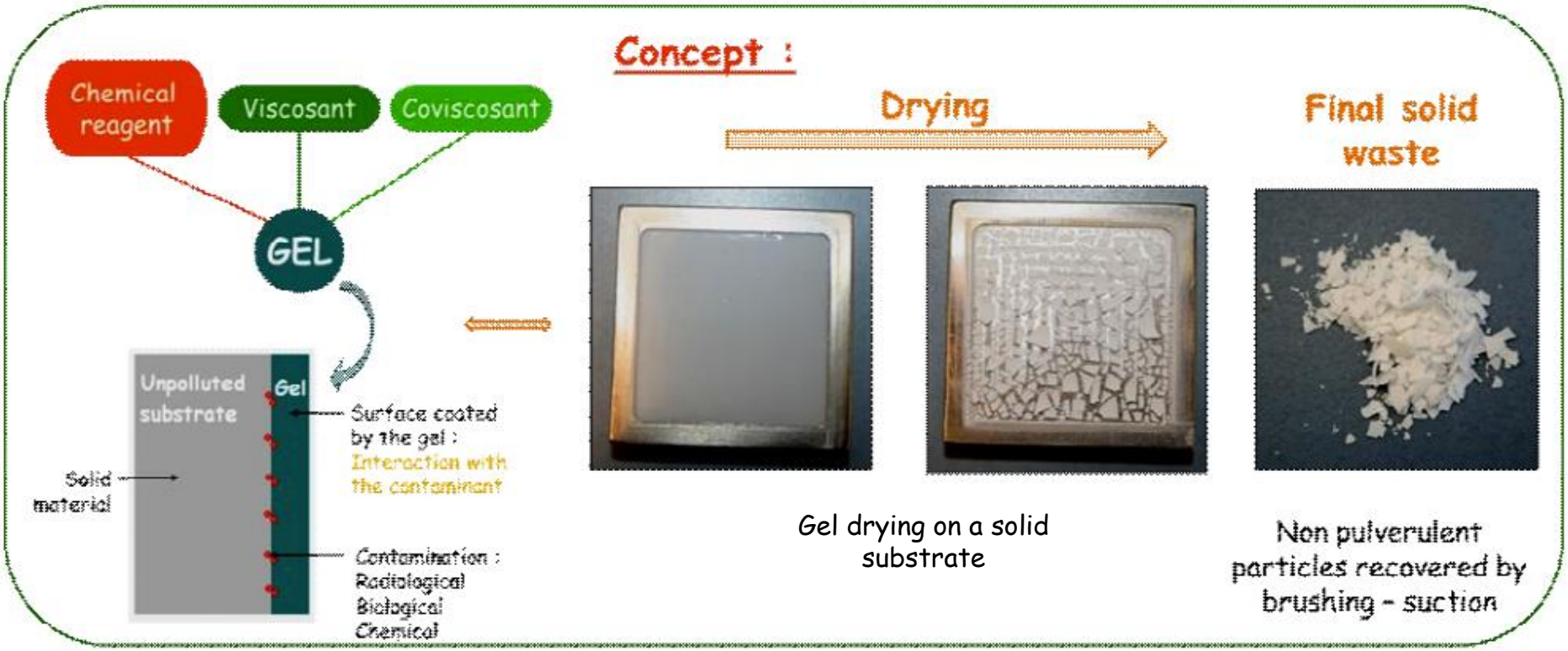
Self drying gel process

- Self-drying Gel is a gel which dries, cracks and comes off from the support. The support is generally slightly eroded in order to remove the fixed contamination. The range of theses gels is named ASPIGEL®.

- Advantages for the decontamination:
  - generate no liquid wastes than other nuclear decontamination products,
  - increase the time contact,
  - improve the efficiency compared to a foaming liquid,
  - Generate less solid waste than quantity of ASPIGEL® used.

Self drying gel process

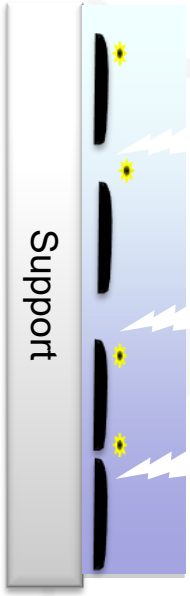
- Initial actions of the ASPIGEL® gels:



Self drying gel process

- Drying and cracking of the ASPIGEL® gels:

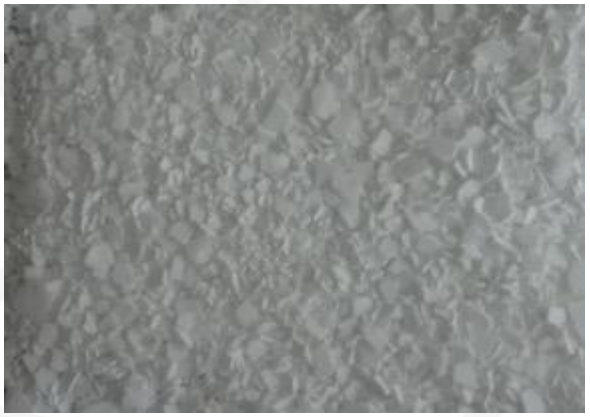
The radioactive particles, dissolved substances et eroding products are covered by the gel which is cracking during its drying



Legend:

Radioactive particles

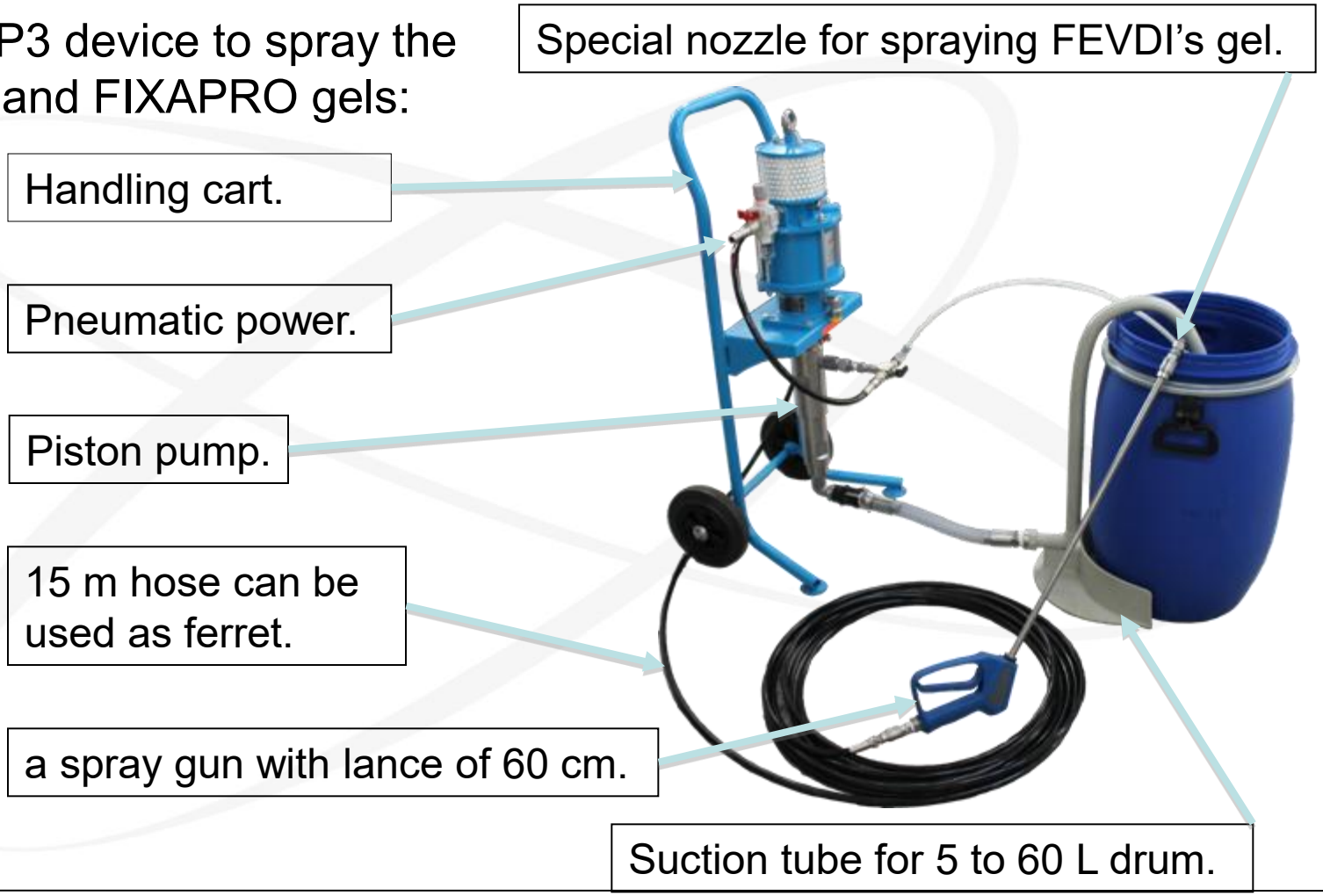
Dissolved substances and eroding products



Dry residues of the gel after drying, closing the contamination, the dissolved substances and the eroded products.

Self drying gel tools

- PUGEL HP3 device to spray the ASPIGEL and FIXAPRO gels:



Self drying gel process

- The ASPIGEL®:

Version	*Features*	*Kind of support*	*Kind of contamination (Decontamination Factor)*
FEVDIRAD OX2-ASP03	Oxidizing Agent PMUC 02-005 (erodes ≈ 0,03 µm)	Stainless steel Inconel	Labile and fixed
GNS 054	Degreaser Agent	All material	Labile (50)
ASPIGEL® 100, 100E or 100V	Oxidizing Agent (erodes ≈ 0,3 µm)	Stainless steel Inconel	Labile and fixed (150)
ASPIGEL® 200	Eroding Agent (erodes ≈ 1 µm)	Ordinary steel	Labile and fixed (150)
ASPIGEL® 300	Eroding Agent (erodes > 1 µm)	Lead	Labile and fixed (200)
ASPIGEL® 400	Eroding Agent (erodes > 1 µm)	Aluminum alloys	Labile and fixed (60)
ASPIGEL® 500	Eroding Agent (erodes > 1 µm)	Concrete	Labile and fixed (4)
ASPIGEL® 600	Eroding Agent (erodes > 1 µm)	Plastics	Labile and fixed

Time of contact 2 to 24 hours depending on the temperature, the humidity rate and the air change rate

ADVANTAGES

Advantages of ASPIGEL GEL compare to foam/washable gel:

- No secondary liquid waste to be treated:
  - The gel dried and cracked and fall from the surface
  - Less waste than product used: 100kg GEL generated around 25kg of waste
- Remove fixed contamination: > 1 µm erosion
- Easy to use:
  - PULVULTRA gun for small surface (1m^2) or PUGEL HP3 for large surface
- Safe to use:
  - 100% mineral after dried pellets

VACLEAN® vaccum cleaner

VACLEAN® has been designed to remove the ASPIGEL pellet while having its motor separated from the vaccum system. This design avoid to get a contaminated motor and facilitate the decontamination of the equipment.

ISAI cells in CEA-Marcoule using ASPIGEL 100

Pulverization of a ASPIGEL 100 thin film (500 µm)

Recovering of the dried pellets by brushing or vacuum cleaning

Coating speed 4 m^2/min
Thickness 1 mm
Material consumption 800 to 1200 g/m^2

Solid waste production < 200 g/m^2

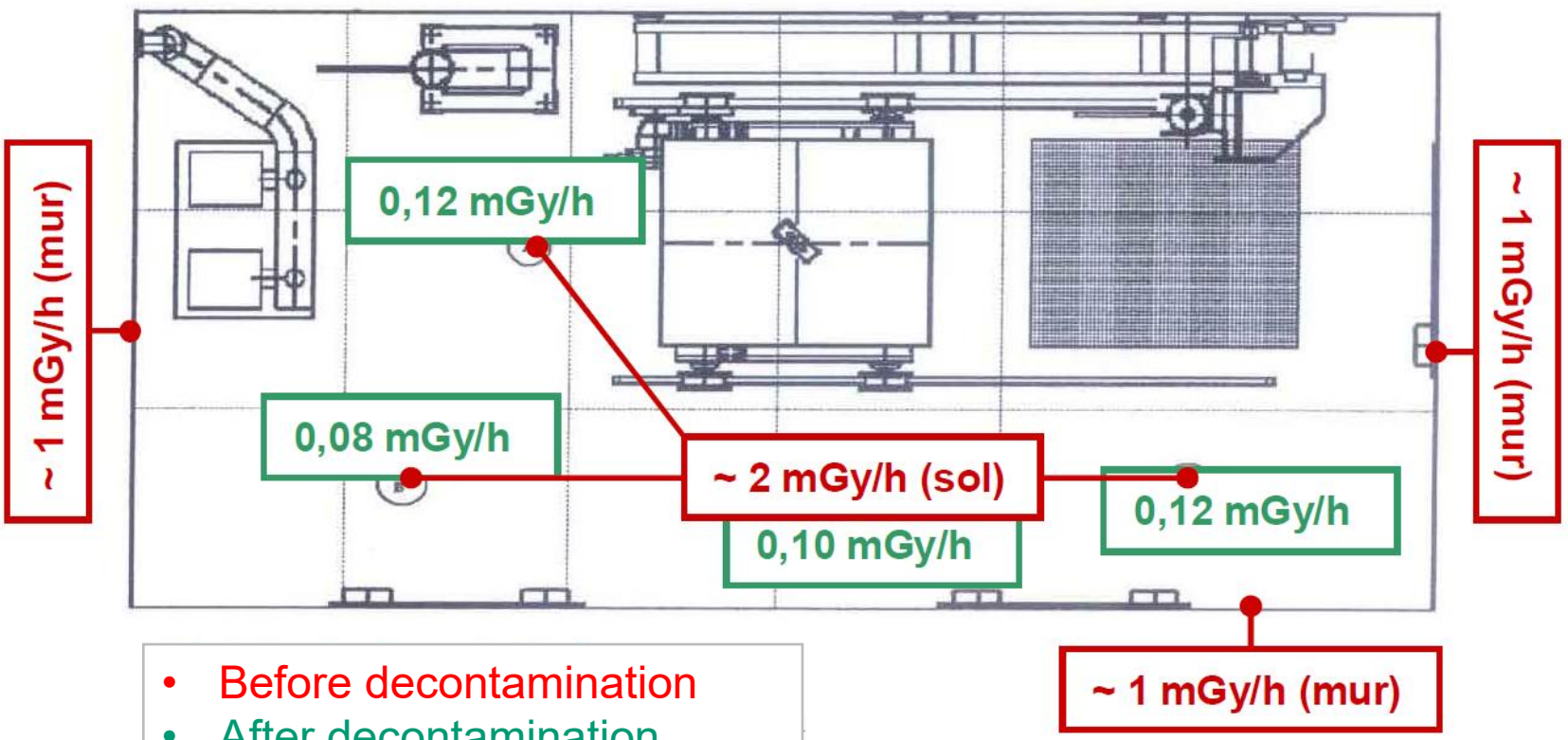
ISAI cells in CEA-Marcoule using ASPIGEL 100

ASPIGEL ISAI Video

ISAI cells in CEA-Marcoule using ASPIGEL 100

- The decontamination surface of the hot cell is 130 m²
- The quantity of ASPIGEL 100 Gel used were 80 kg
- The solid waste of dried residues were 20 kg
- The decontamination factor : 17 < FD < 25
- The dried wastes are 100% minerals and can be stored safely in waste drum and compacted.

Result



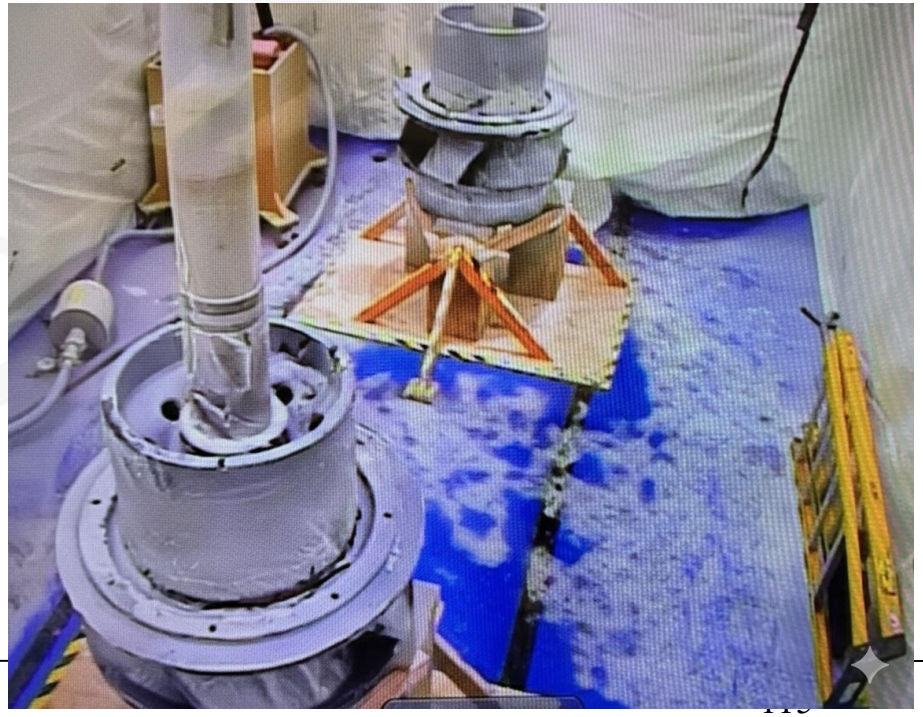
- Before decontamination
- After decontamination

GNS 054

- GNS 054 is a auto dry gel to remove dust, labile contamination and degrease supports without produce any liquid waste.
- The GNS 054 is similar to the ASPIGEL with decontamination properties but can remove only labile contamination.
- GNS 054 is a neutral product and can be use very easily on every type of materials.
- FEVDI own product design

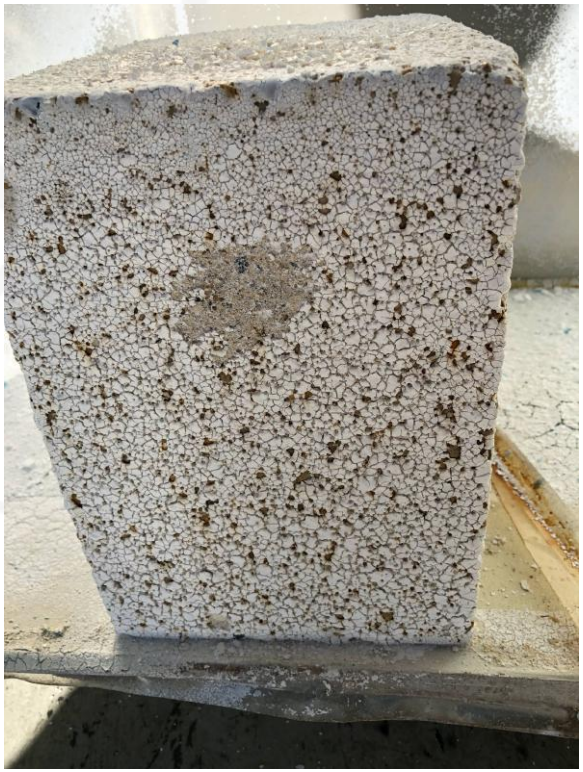
USA David Besse project

- Removal of loose and fixed contamination of primary pump wheel impeller
- One pass of GNS054 to remove the loose contamination
- One pass of ASPIGEL100 to remove the fixed contamination
- Result to go from Class B to Class A according the USA NRC standard



ASPIGEL® 500

ASPIGEL 500	Eroding Agent (erodes > 1 µm)	Concrete	Labile and fixed (4)



ASPIGEL® 500

ASPIGEL 500 Video

Concrete protective layer

PROTECBETON is a concrete protective is a 100% mineral product that produce glass inside of concrete pores. This creates a physical barrier avoiding concrete to be contaminated.
It is be used after decontamination to prevend secondary contamination.

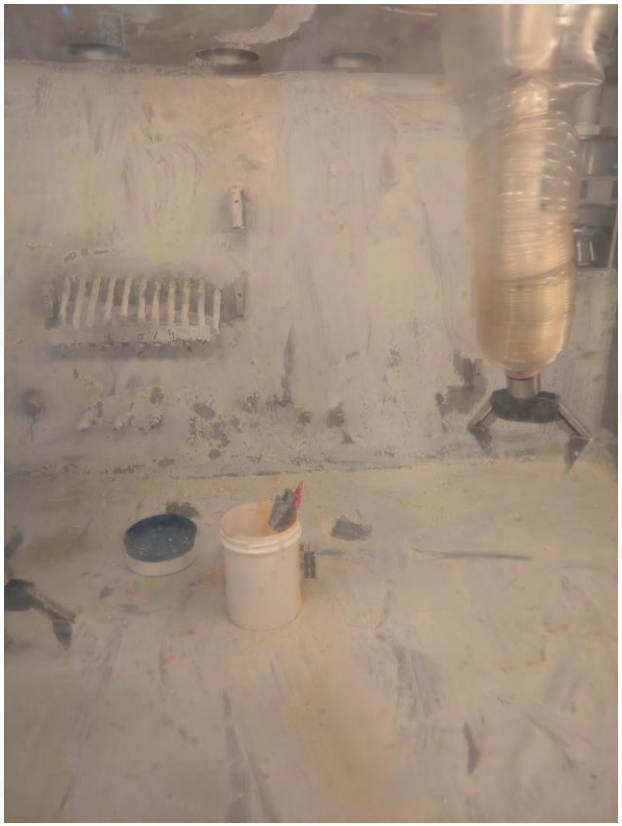
Protected concrete

Non protected

Concrete protective layer

PROTECBETON Video

Hot cell manual application



Labile decontamination with no liquid waste with the peelable Protective film FIXAPRO P02/P03

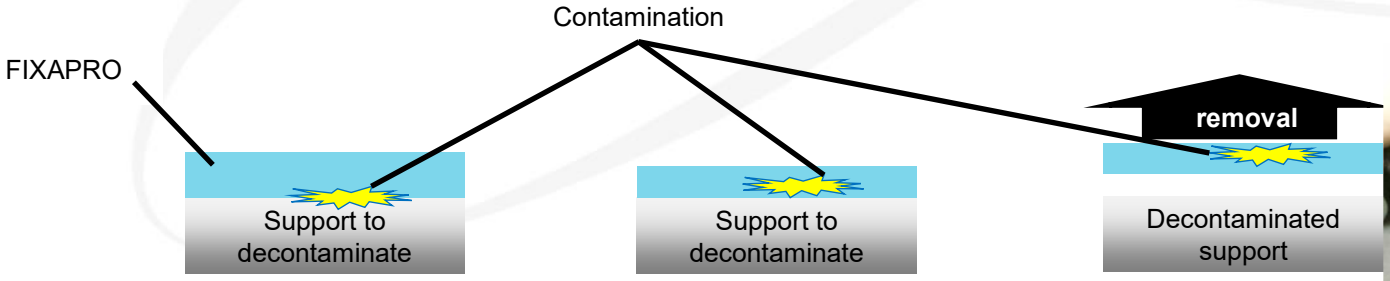
Decontamination with peelable film

General procedure:

I.the product is initially a gel which is sprayed upon the support,

II.the product dries into a peelable film between 2 and 4 hours of drying,

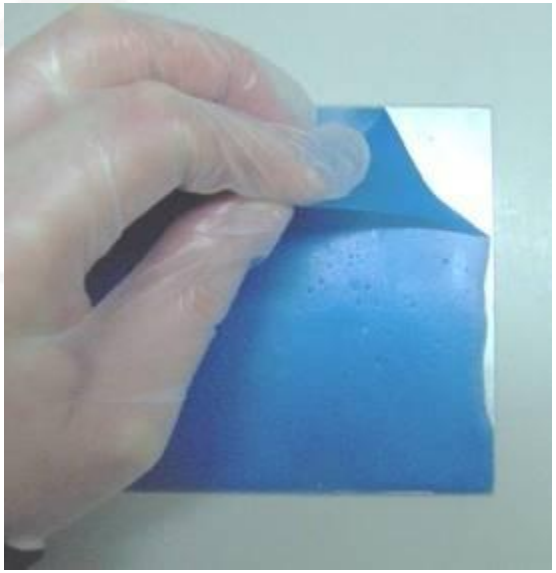
III.The film is manually removed.



Decontamination with peelable film

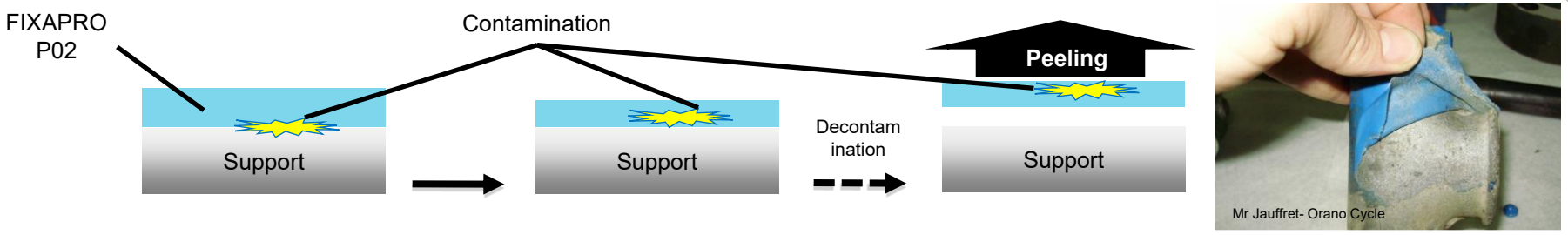
- FEVDI has several products which can become a peelable film :
  - FIXAPRO P02 for decontamination only,
  - FIXAPRO P03 (PMUC) for protective using because less adhesive than P02.

- Advantages for the decontamination:
  - FIXAPRO can be used on all kind of support,
  - No risk of reaction with the support except upon polycarbonate (adhesive),
  - Generate less solid waste than the quantity of FIXAPRO used,
  - High irradiation resistance for a cumulated dose until 10 MGray.



Decontamination and protection application

- Application of FIXAPRO P02 and FIXAPRO P03 (PMUC):
  - Decontamination.



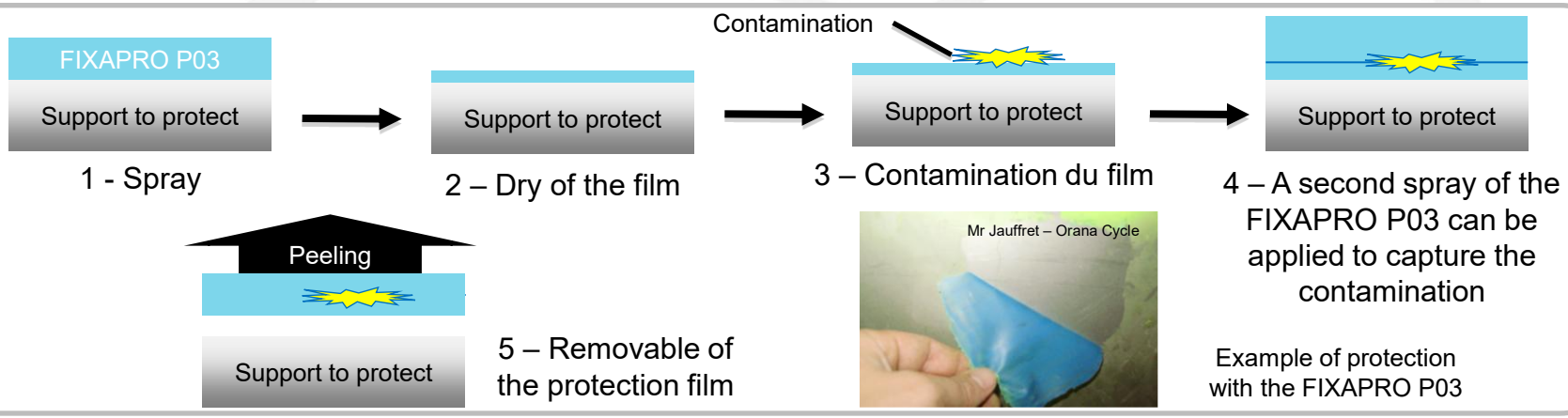
1- Application with a spray gun

2 – Dry of the film

3 - Decontamination

Decontamination of the FIXAPRO P02

  - Support protection.



1 - Spray

2 – Dry of the film

3 – Contamination du film

4 – A second spray of the FIXAPRO P03 can be applied to capture the contamination

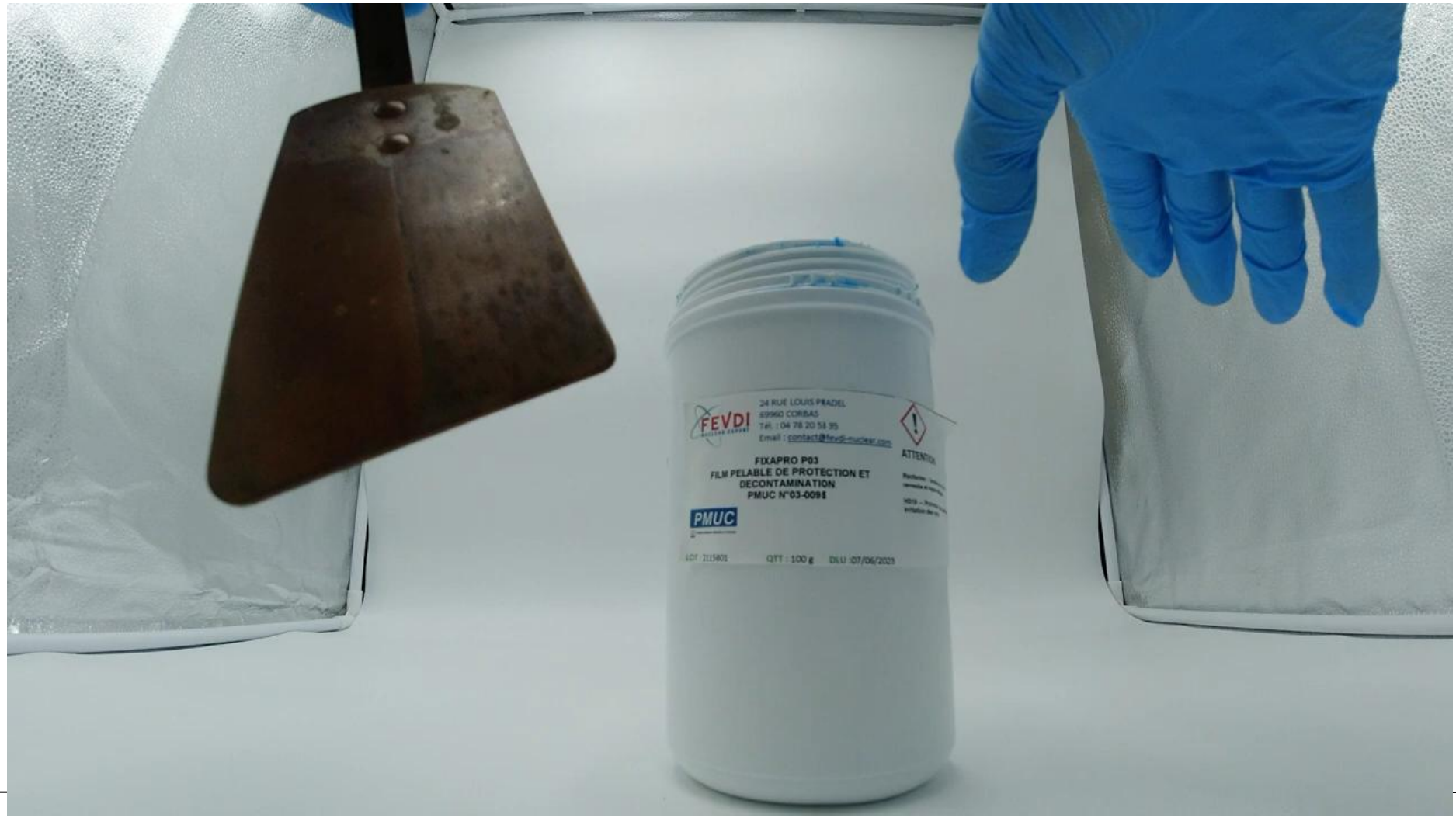
5 – Removable of the protection film

Example of protection with the FIXAPRO P03

FIXAPRO P03

FIXAPRO P03 video

FIXAPRO P03



FIXAPRO P03 video

PROJET PRO 350M

For large surface application, FEVDI designed the PROJET PRO 350M:

-The flexible cane can be inserted into a 5 to 20 L drum,

-Pressure range : 50 to 110 bar,

-Power: 600 W,

-Maximum Flow rate: 1.5 $L.min^{-1}$,

The pump cart can be folded for convenient storage.

PROJET PRO 350 M Video

PULVE ULTRA 18V

PULVE ULTRA 18V is designed to paint small surfaces:

-Capacity of 1 L,

-Handheld gun,

-Use battery with an autonomy enough for three spraying actions (3,9 L),

-Available with power cable (220V).

PULVE ULTRA 18V Video

ADVANTAGES

Advantages of FIXAPRO P02/P03 compare to foam:

- No secondary liquid waste to be treated:
  - The film can be peeled off easily and compacted
- Remove labile contamination and can be used as protection for parts during decommissioning, for example to protect waste drum surface, tools surface such as robots, radioprotection material.
- Easy to use:
  - PULVE ULTRA guns for small surface (1m²) or PROJET PRO 350M for large surface

Case study

- Customer: CEA France

- Test of FIXAPRO P02 on different type material surface
  - On bitumen: surface 1,5 m²
  - On concrete: surface 1 m²
  - Stainless steel surface of 1 m²
- Those tests have been made outside under 25 degree.
- 5 L has been necessary to cover those 3 surfaces.
  Each layer has a thickness of 0,3 mm.
  After 2 hours, the coating is relatively dry to be removed.
  After 24 h, it is completely dry; the coating can still be removed easily.

Case study

Test of the FIXAPRO P02 on the different types of material surfaces


(Surface de test)


(Système de pulvérisation)


(Pistolet de pulvérisation)


(Présentation du produit)


(Mise en place du produit dans le pulvérisateur)


(Pulvérisation du produit sur les supports)


(Pulvérisation du produit sur les supports)


(Pulvérisation du produit sur les supports)


(Aperçu du produit après pulvérisation)


(Aperçu du produit après pulvérisation)


(Aperçu du produit après pulvérisation)


(Peinture après arrachement).

Case study

Customer: ORANO France

This test has been made is order to test the efficiency as being decontamination product and as being a protection coating to protect material going on contaminate area with Tritium.

- Between 400 to 600 g/m² is covered on the surface.
- The decontamination of the material has been tested on two types of materials (stainless steel and painted carbon steel)
- The test process follows the below steps:
  - Radioactivity test of the equipment,
  - Application of the coating,
  - Wait at least 2 hours for the drying process,
  - Removal of the coating,
  - Radioactivity test of the equipment.

Case study

Test stainless steel: pump part

1. Initial Radiological test : 1839 Bq/cm^2.
2. Application of the coating with a brush.
3. Removal of the coating after 2 hours of drying.
4. Radiological test: 40 Bq/cm^2.
5. DF = 46.

Case study

Test on carbon steel: surface of a vessel

1. Initial Radiological test : 1849 Bq/cm^2.
2. Application of the coating with a brush.
3. Removal of the coating after 2 hours of drying.
4. Radiological test: 260 Bq/cm^2.

1. Second application on the same part
2. Final Radiological test: 81 Bq/cm^2

1. DF = 23

Case study

Decontamination of laboratory fume cupboard

1. Decontamination of sink
2. Before decontamination:
    1. C14= 33,90 kBq/smear.
    2. Tritium = 0,83 kBq/smear
3. After decontamination with FIXAPRO P02
    1. C14= 0,015 kBq/smear.
    2. Tritium = 0,002 kBq/smear

Case study

Test on stainless steel as protection

1. Application of the FIXAPRO P03 on non-contaminated equipment.
2. After 2 hours of waiting for the drying process the part goes into a contaminated glove box of Tritium.
3. The removal shows: 285 Bq/cm².
4. Removal of the coating.
5. Radiological control of the part only: 0,01 Bq/cm².

Stripping of contaminated paint with BIODECAP GEL

Paint stripping

BIODECAP 02 GEL
BIODECAP 03 GEL
BIODECAP 04 GEL

Stripping of contaminated paint

BIODECAP GEL is active on many cross-linked paintings: epoxy, polyurethane, etc. It allows to strip highly reticulate paints, in thick layers with a fast reaction time.

The viscosity of the GEL allows to be applied on vertical surface

Case study

- Customer: GE France

- Removal of two layers lead contaminated paint coating on horizontal surface with BIODECAP 04 GEL

Application of BIODECAP 04 GEL

Reaction after 24h

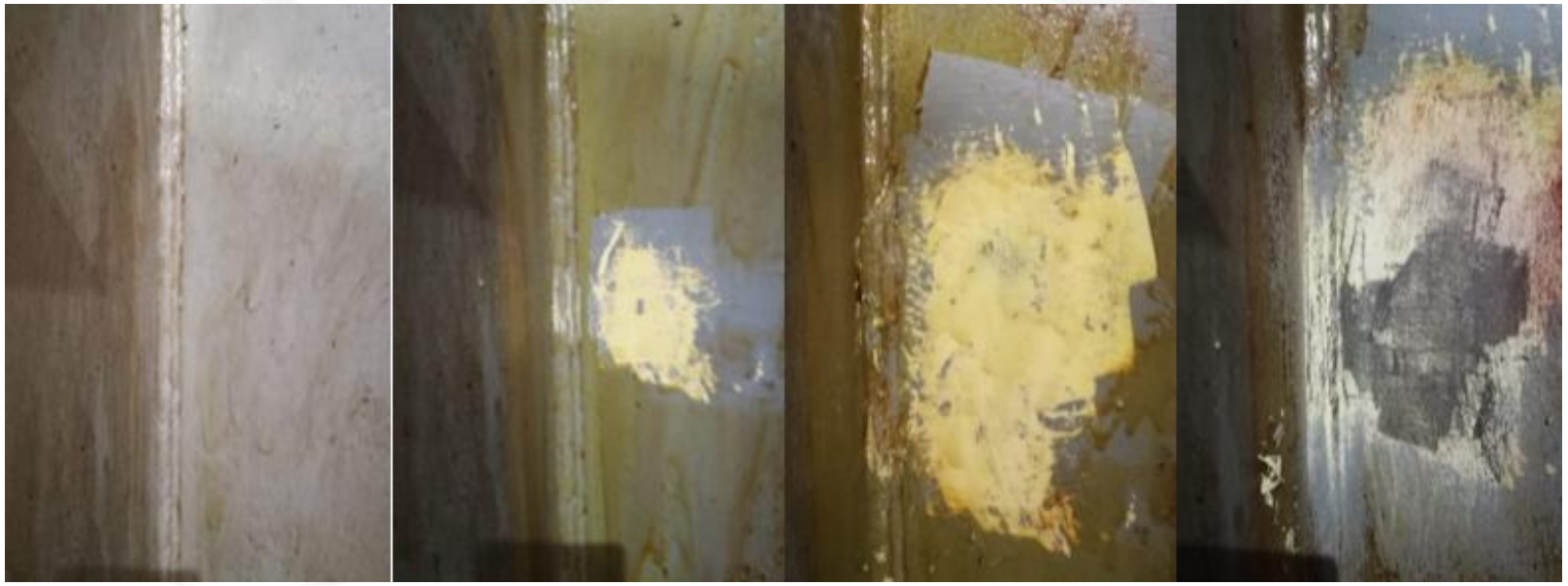
Removal of the paint

Removal of the paint with a wire brush

Case study

- Customer: GE France

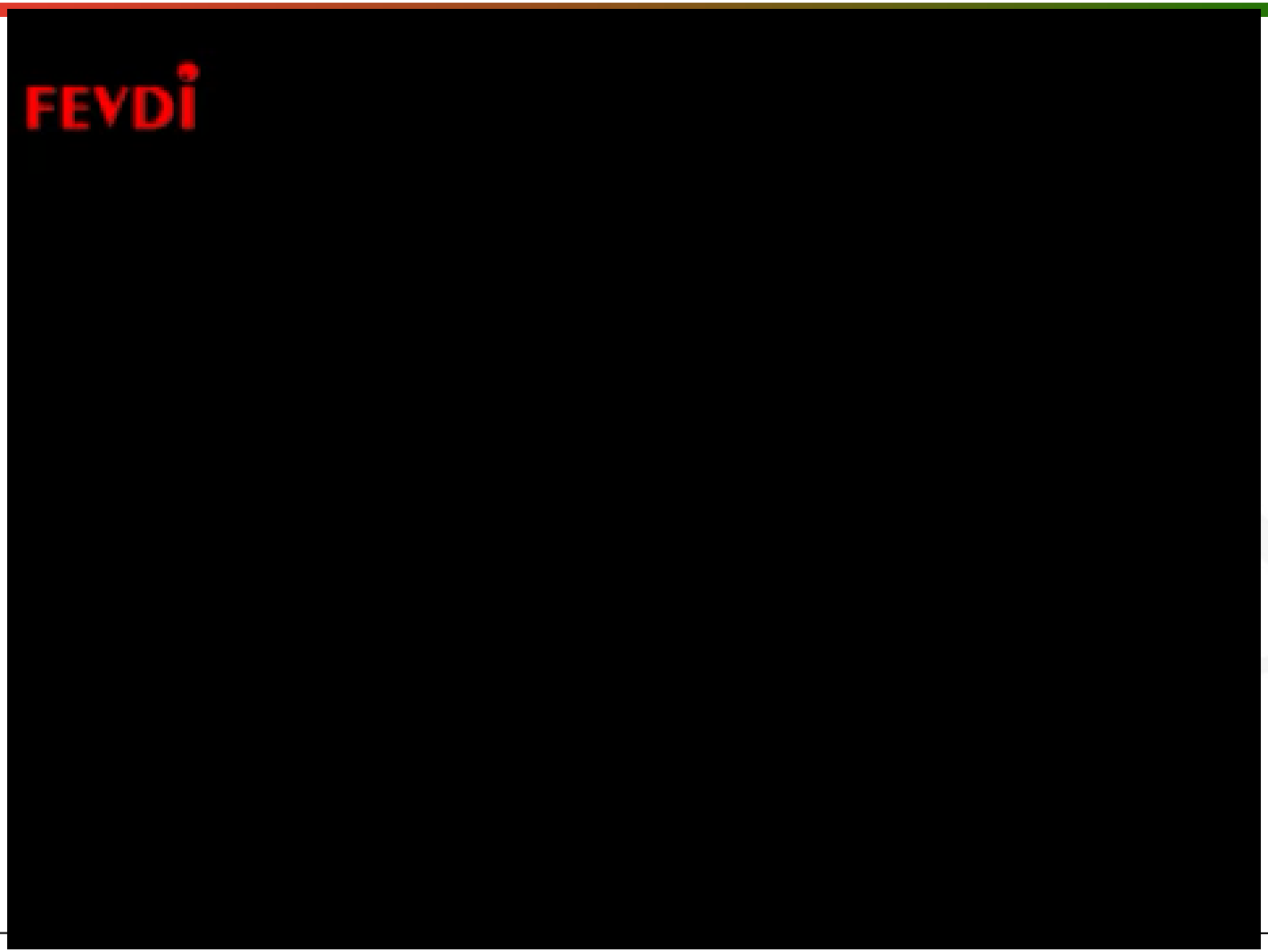
- Removal of lead contaminated paint coating on vertical surface with BIODECAP 03 GEL



Application of BIODECAP 03 GEL	Reaction after one hour	Removal of the paint after 2.5 h	Vertical painted coating removed

BIODECAP GEL

BIODECAP GEL



BIODECAP GEL Video

Protective and fixative film

Cloth fixative film

Aerofix

- Aerofix is used to fixe the contamination on cloths and tissue.
- This avoids any contamination when taking out the cloths or suits.
- In aerosol spray or in liquid version

Cloth fixative film

AEROFIX Video

Fixative film

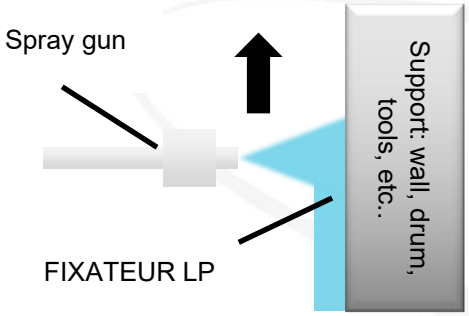
- FIXATEUR LP5 (colorless) and FIXATEUR LP6 (white) are protective film for temporary or permanent protection

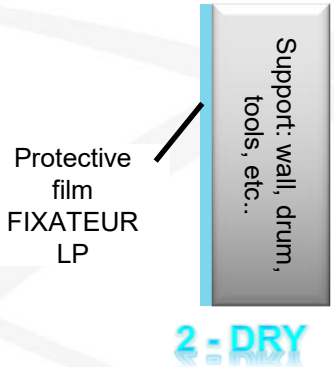
- They are weakened by so called « weaken » product such as the FEVDIREM DNB for LP6. They are then removed by water.

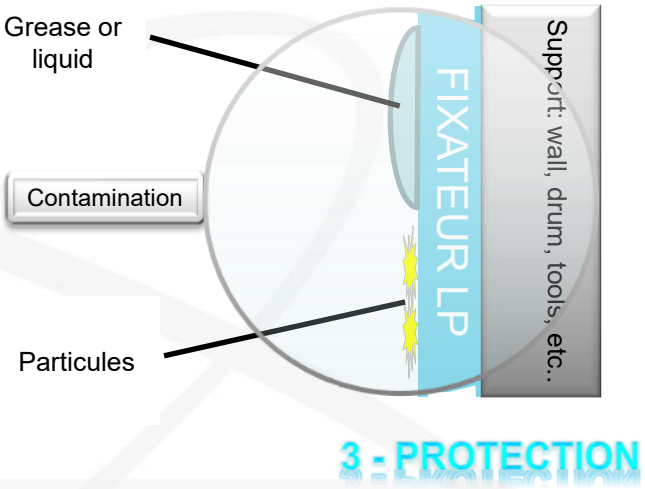
- The FEVDIREM DNB is non foaming decontaminant alkaline

Process

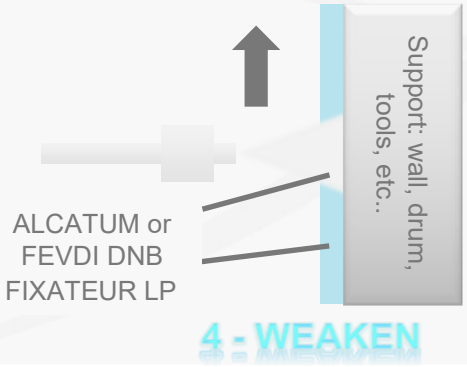
- Application process

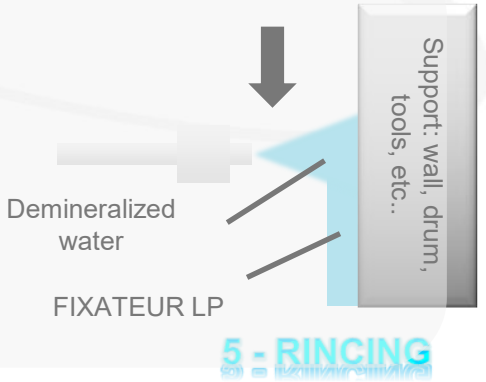






If temporary:





Fixative film

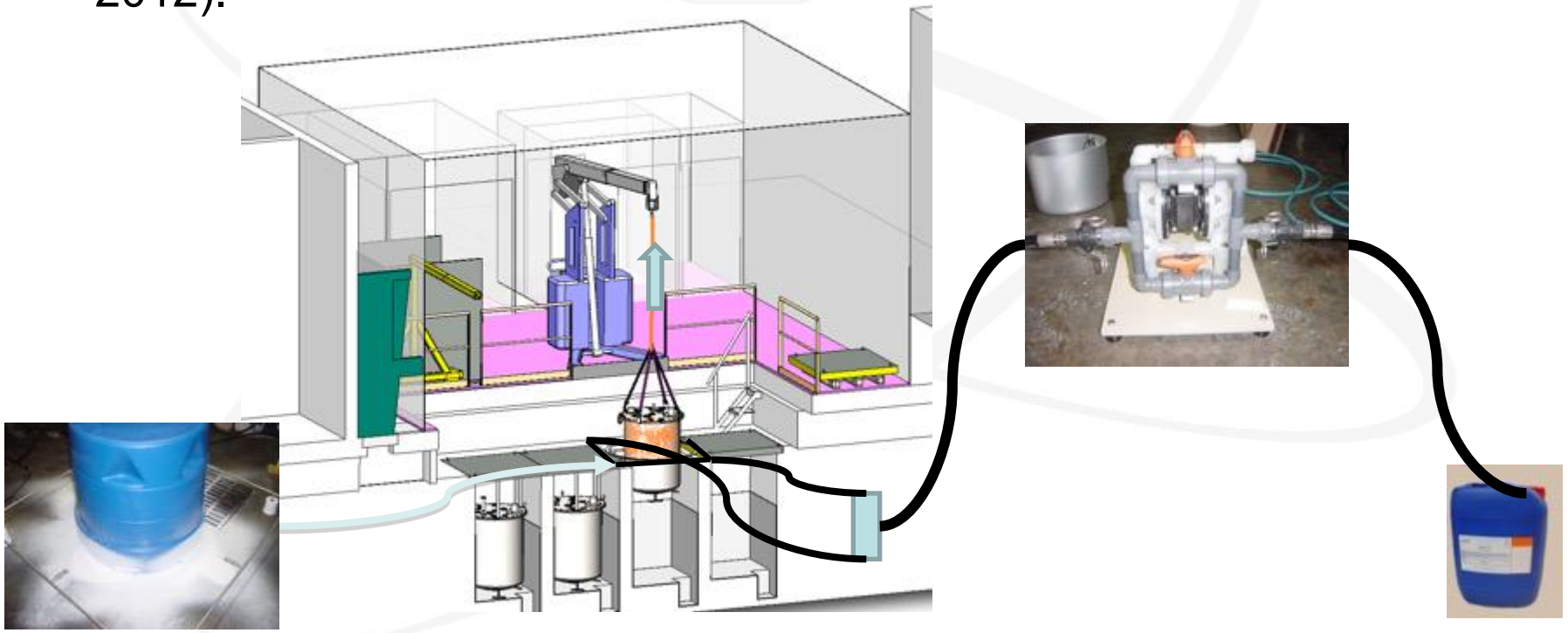
ADVANTAGES of FIXATEUR LP5 (colorless) and FIXATEUR LP6 (white)

-Radiation resistant
-Non dangerous class product
-Spray at low pressure
-Large coverage: 1L = 10 m²
-Dry in few hours
-Apply to all surface smooth or porous
-Resistant to fire during flame cutting

Cloth fixative film LP6

Example protective film application

- Protective film of the contamination in order to remove drums for future decommissioning. (reference CEA Fontenay-aux-Roses 2012).



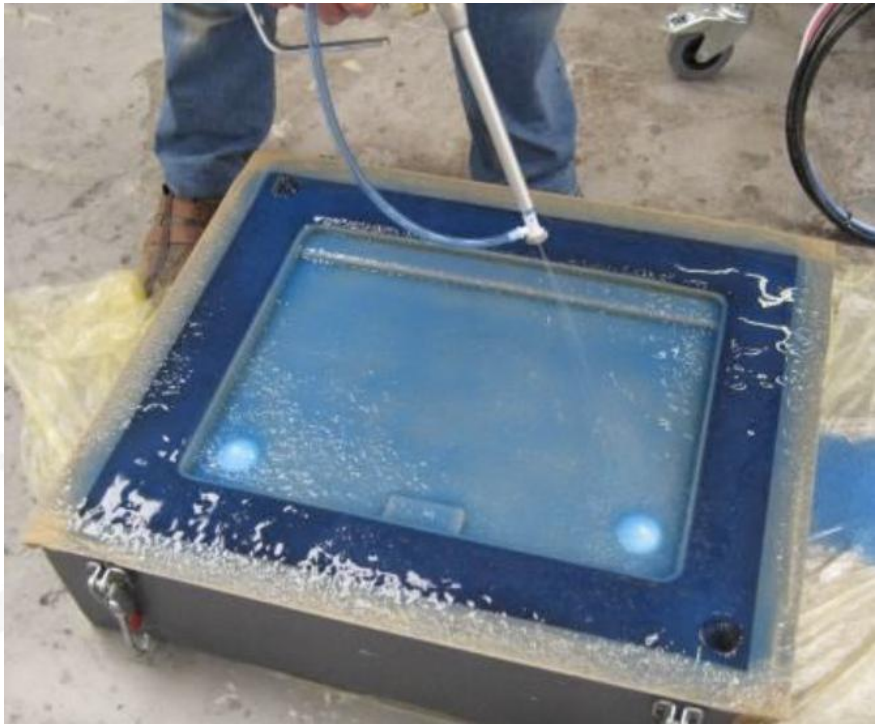
Specific Application

FEVDISIL PB

FEVDISIL PB

FEVDISIL PB is a two-component creating a physical barrier film.

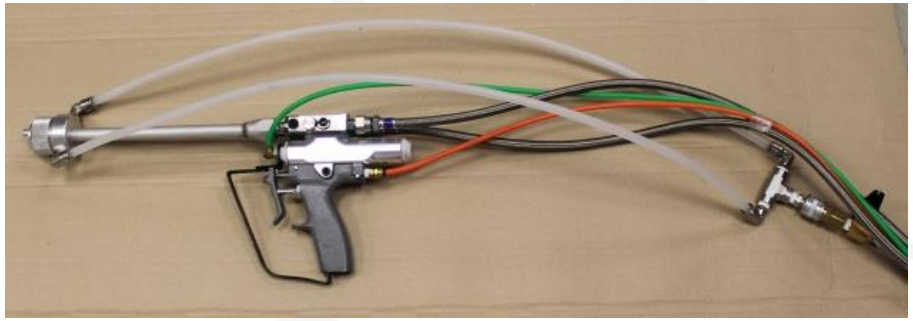
FEVDISIL PB can polymerize even under water.



FEVDISIL PB

PUGESIL 1:1

Two component spray device with two 50L containers to spray at 0.8 to 3kg/min



Manual with cartridges

FEVDISIL PB

Plastic decontamination

DECONTAPLAST

Decontamination of plastics

DECONTAPLAST has been tested on various plastics and Plexiglas. Its action is very slow and can eliminate the fixed contamination on plastics. The attack is progressive in contact with the product. DECONTAPLAST does not change the transparency of PVC and Plexiglas (LEXANS), plastic, polyethylene, polypropylene, nylon, EPDM, rubber (shoes)

Dissolving glue

•BIOSOLV N7 GEL (PMUC 01-0161) is used to dissolve glues of joints adhesives of Steam Generator taps and other adhesives, resins and inks. Degreasing of parts. Flash point 43 °C.

The BIOSOLV N7 is used to remove glue

Fast drying degreasing and decontamination

- The FEVDISOLV N5 (PMUC) is an aliphatic solvent, non corrosive. With a fast evaporation rate, FEVDISOLV N5 is very good for degreasing and decontamination of mechanical parts and bolts.
- The FEDISOLV N5 is used pure.

The FEVDISOLV N5 dries in 10 minutes in normal use

Laundry washing

NUTRIUM

ENZYMATIC WASHING LIQUID FOR NUCLEAR CONTAMINATED LAUNDRY

- **NUTRIUM** has been developed specially to decontaminate cloth in any textiles, cotton or synthetic, and shoes used in nuclear environment.
- **NUTRIUM** avoids the laundry become yellow and grey.
- Contain surfactant but low foaming
- **NUTRIUM** is not affected by the hardness of the water.

Laundry washing

FEVDIREM MD

Wetting agent, prewash

PMUC 02-0001

FEVDIREM AST

Fabric softener agent for laundry

PMUC 02-0020

FEVDIREM DT2

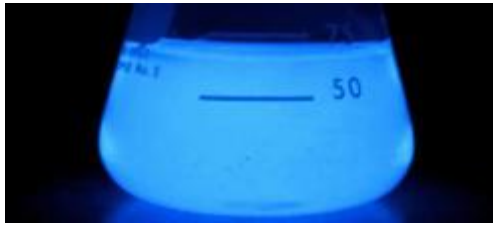
Descaling of washing machines

Siphon holding

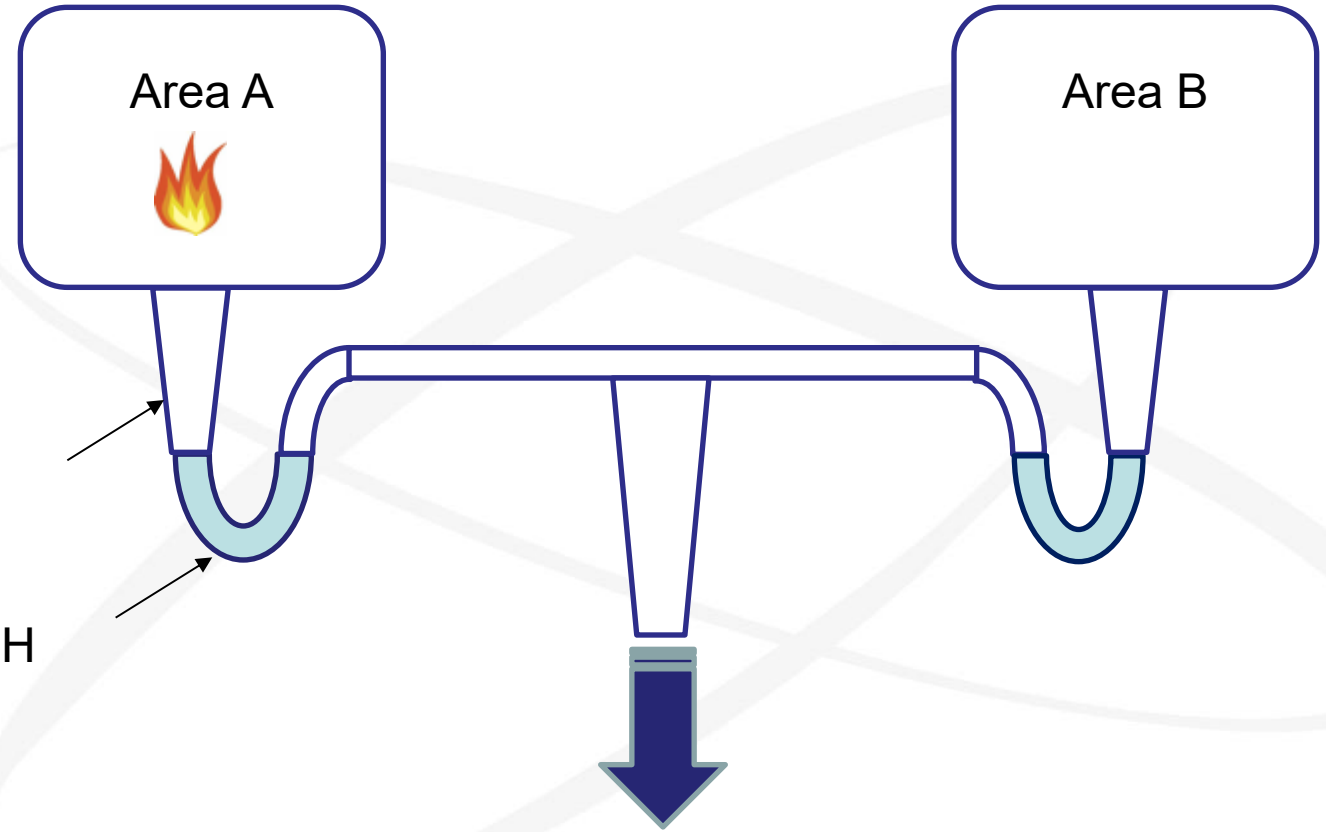
RETENSIPH

- Product with a very low evaporation rate, specially formulated for the filling of holding tanks and siphons. Prevents air calls from ducts, in rooms with depression. In case of fire, prevents the spread of fire and gases.

- A new RETENSIPH with UV light reflection has been developed to facilitate the detection of the liquid level

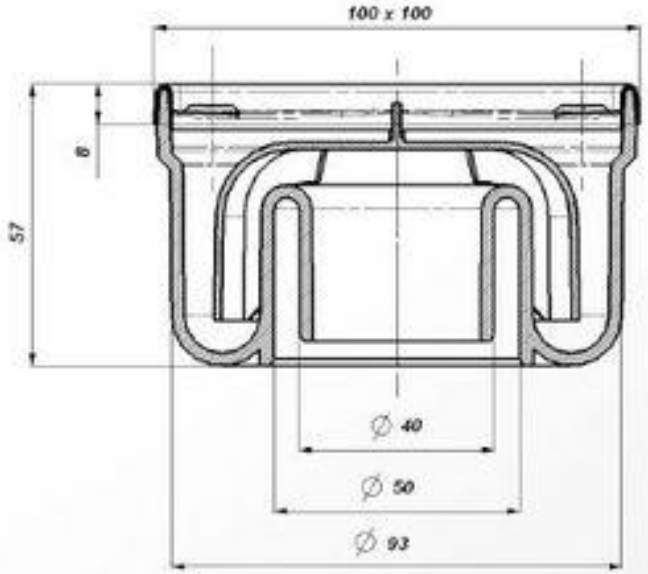


Fire risks situation



The RETENSIPH evaporates 30 to 60 times slower than water.

Nuclear Siphon



In France, according to the French Nuclear Safety Authority ASN, it is mandatory to fill all the siphons in EDF NPP. ASN also recommand the application of RETENSIPH.

RETENSIPH UV

RETENSIPH UV Video

Nuclear stainless steel passivation

PMUC Passivation of stainless steel

- FEVDIRAD AC2 (Liquid, foam or gel) are used as passivation for stainless steel, the product is PMUC label and is widely used for EDF project.
- The gel form can be used on vertical surface.

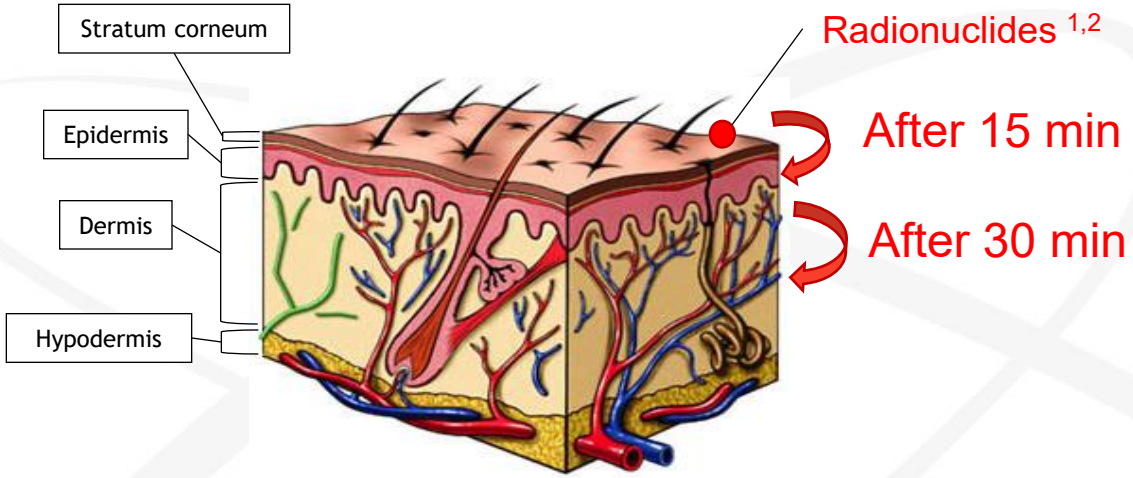
NDT Penetrant and Developer

FEVDI AIR:
FEVDI AIR PENET Red eye penetrant
FEVDI AIR REVEL White Developer

- FEVDI AIR PENET and REVEL are respectively Red eye penetrant and White developer for NDT application.
- Those aerosol are rechargeable with compressed air up to 10 bars

Skin Decontamination

Skin decontamination



Fast diffusion even through intact skin [1]

Blood and tissue distribution

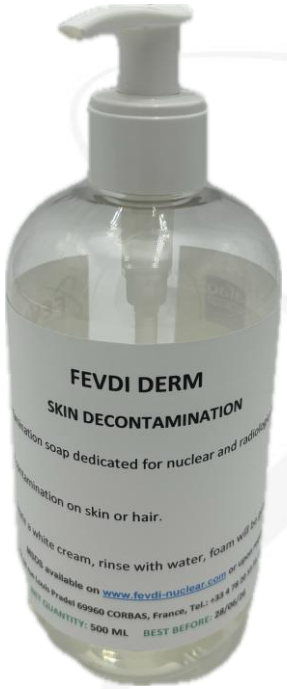
Toxicity in retention organs and skin [2]

(1) De Rey et al., Environ. Res., 1983; 30(2):440-91
Petitot et al., Can. J. Physiol. Pharmacol., 2004; 82(2):133-9

(2) Lopez et al, Health Physics, 2000; 78(4):434-7
Kathren and Burklin, Health Physics, 2004; 94(2):170-9
Brugge et al, Rev. Environ. Health, 2005; 20(3):177-93

→ This is why we should act quickly

Skin decontamination



FEVDI DERM

High efficiency gel for skin decontamination

- **FEVDI DERM** has been developed specially to decontaminate skin and hair.

- **FEVDI DERM** does not contain any perfume and colorant

Reduce surface contamination

FEVDI GLASS

FEVDI GLASS

FEVDI GLASS
Nano structured barrier

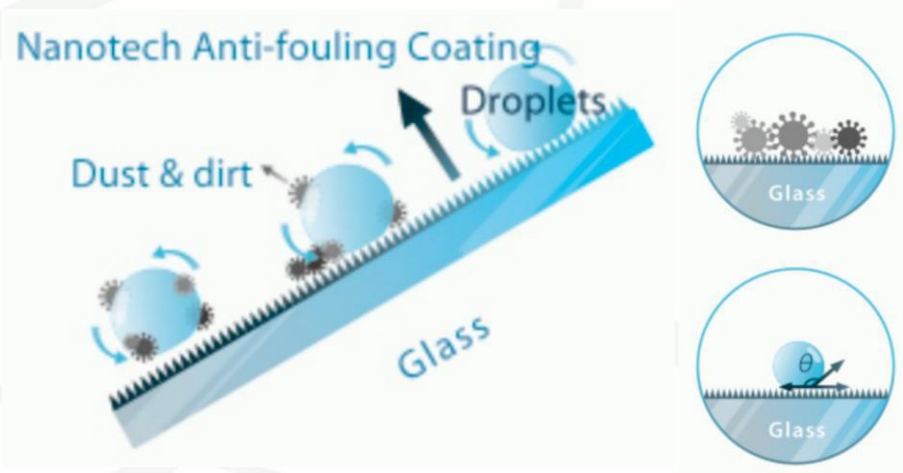
FEVDI GLASS is nano structured coating (30-50 nm) to be applied on lead glass and plexiglass to provide a self cleaning performance.

- Superhydrophobic and oleophobic properties enable water to bead and carry away minimizing manual decontamination.
- Can be applied by spray, wiping or roller.
- Cures in 2 days in ambient temperature
- Water based, as no solvent

FEVDI GLASS

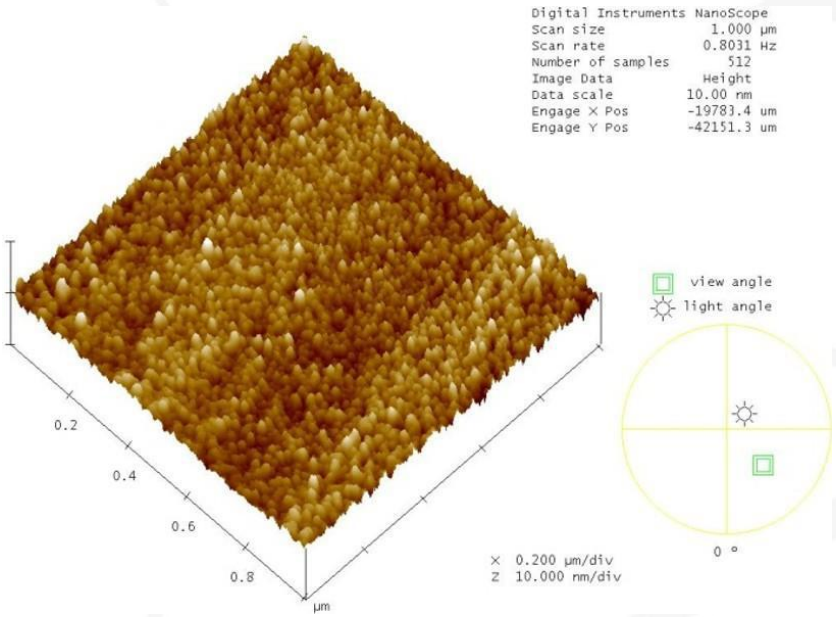
FEVDI GLASS
Nano structured barrier

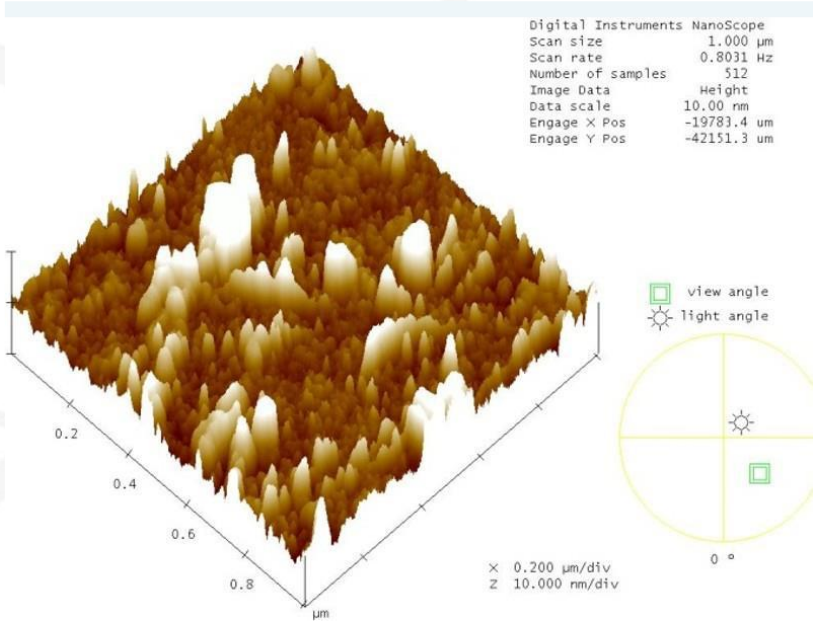
- Water contact angle: > 100°
- Hardness: 9H
- Acid resistance: 10% in HCl solution
- Transparency: > 99%
- Storage condition:
  5°C~70°C, 40%~90% humidity
- Application condition:
  10°C~40°C, 40%~90% humidity



FEVDI GLASS

FEVDI GLASS
Nano structured barrier





- Before and after coating application in micron size

Liquid waste decontamination

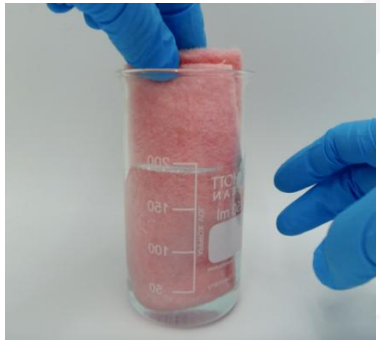
NUCABLOCK

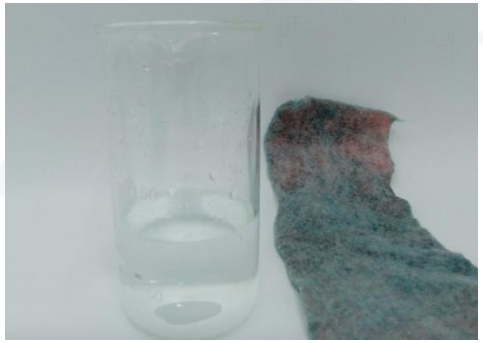
NUCABLOCK

NUCABLOCK:
Fabric to remove heavy metal

NUCABLOCK is a fabric to remove the polluted particle such as heavy metal with a high absorption capacity. The special fibre keeps the element inside of its fibres.

For Cu^{2+} : the absorption is 100mg to 156mg per g of fibres



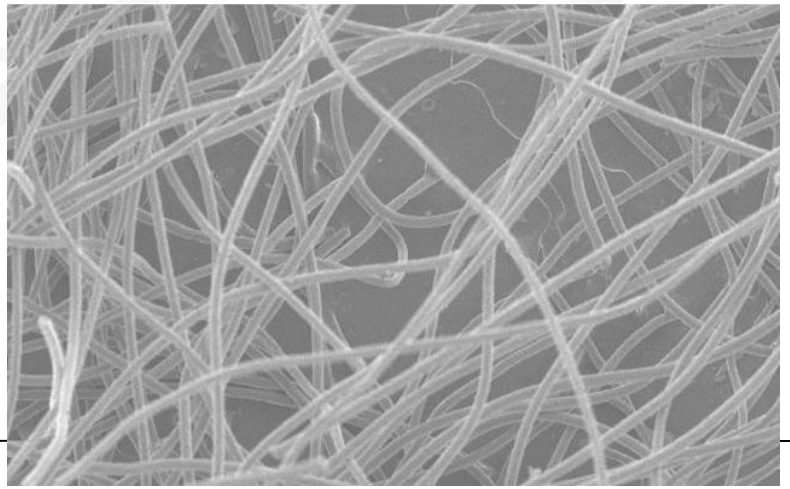


NUCABLOCK

NUCABLOCK:
Fabric size with fiber of 30 micron

Heavy metal capture:
Copper (II), Nickel (II), Zinc (II), Cadmium (II), Cobalt (II), Strontium (II), Lead (II), Magnesium (II), Chromium (III), Iron (II)

Maxi temperature: 80 to 100°C
pH range: 1-12



NUCABLOCK is sold in m² with
Width of 0,75 m
Density of ~450g/m²,
Thickness: ~4-5 mm
Price is 155 Euro/m²

NUCABLOCK in copper solution

Demo video

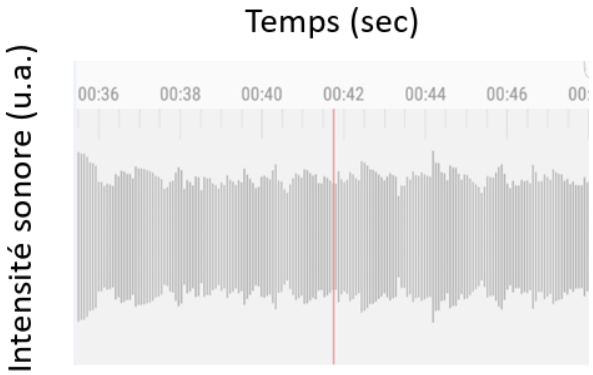
Iodine test

In hospital for nuclear medicine, urine volume reduction is a key challenge.

Test of a small volume of urine contaminated by iode131 at 740 MBq.

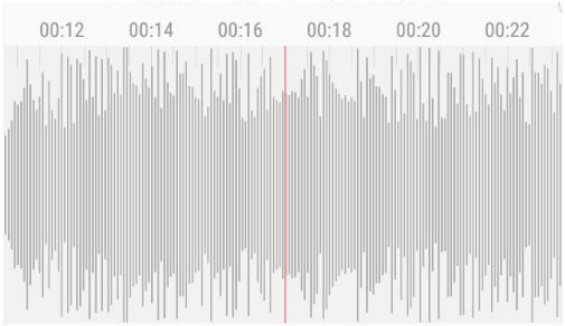
Use of 2 mg of NUCABLOCK inside of a syringe.

Iodine test

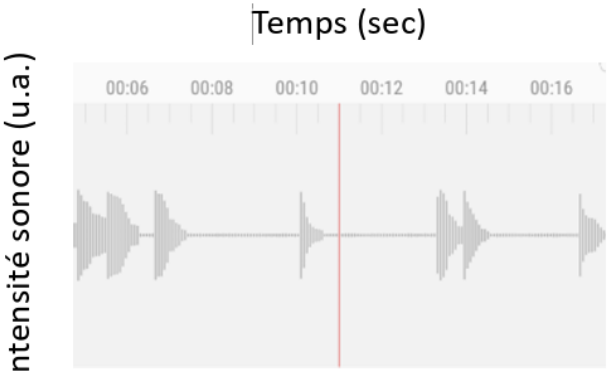


Activity before decontamination

Activité concentrée dans la colonne



Activity of Iodine 131 the NUCABLOCK



Activity after decontamination

Leaking pillows

RADIOSOCK:
Leaking pillows to prevent radiological contamination leaking

- RADIOSOCK is a dry pillow that capture the contamination leaving the excess water without the contamination.
- It can absorbs 300 ml liquid in 6 seconds.

Liquid waste volume reduction

PWR HEST

HIGH-EFFICIENCY SOLIDIFICATION TECHNOLOGY FOR PWR CONCENTRATE WASTE (PWRHEST)

FEVDI is under discussion with Taiwan to import and improved the High efficiency solidification technology.

This innovative solution can reduce the drum volume reduction by a factor of 6 and is already implemented in Taiwan and in the Japan.

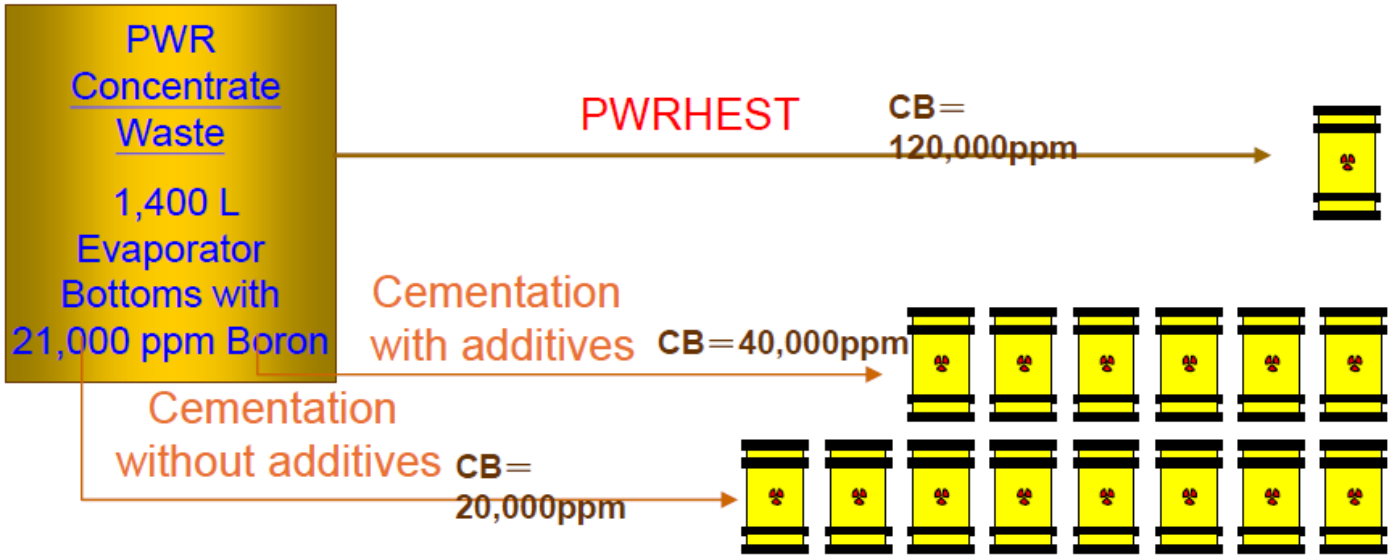
The HEST system consists of two subsystems, a super-concentration subsystem and a solidification subsystem. The super-concentration subsystem is able to concentrate the waste solution to a total boron content as high as 130,000 ppm prior to solidification.

The higher boron content will result in greater volume reduction efficiency of solidification. The solidification subsystem consists of an in-drum mixing and a conveyor units.

HIGH-EFFICIENCY SOLIDIFICATION TECHNOLOGY FOR PWR CONCENTRATE WASTE (PWRHEST)

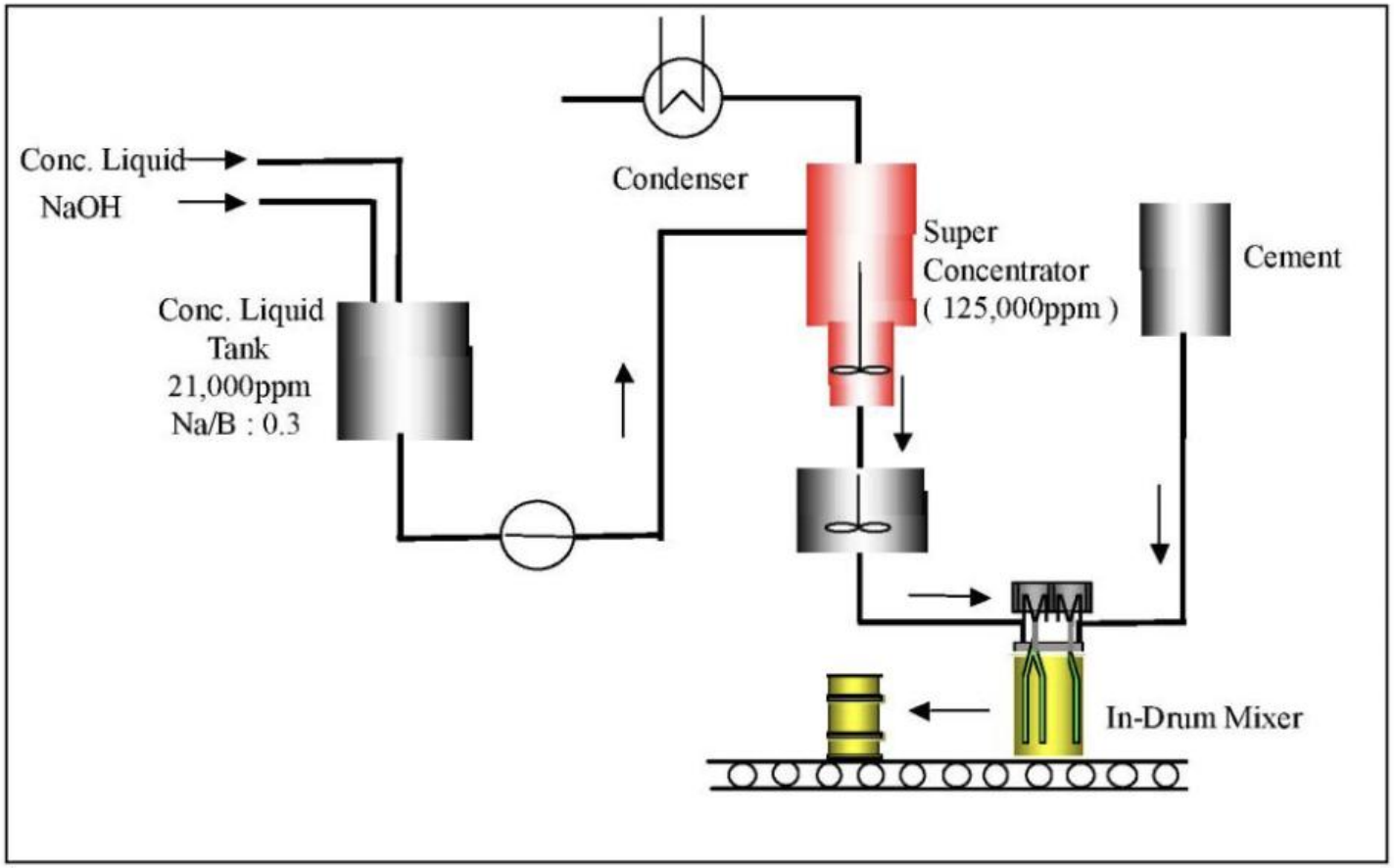
- High concentrated boron waste up to 130 000 ppm can be solidified
- Fast solidification reaction even with high content of boron, setting time is 40 min
- Low curing temperature, peak temperature of a 200L waste in 90°C.
- Solidification agent is 0.25 to 0.3 by weight
- Dry base waste (borate) in the solidified product exceeds 50 wt%.

HIGH-EFFICIENCY SOLIDIFICATION TECHNOLOGY FOR PWR CONCENTRATE WASTE (PWRHEST)



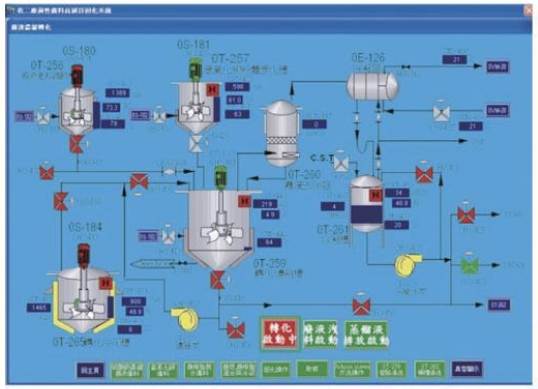
Comparison of Solidified-Waste Volume Generated by Different Solidification Method

FEVDI input in the chemical solution



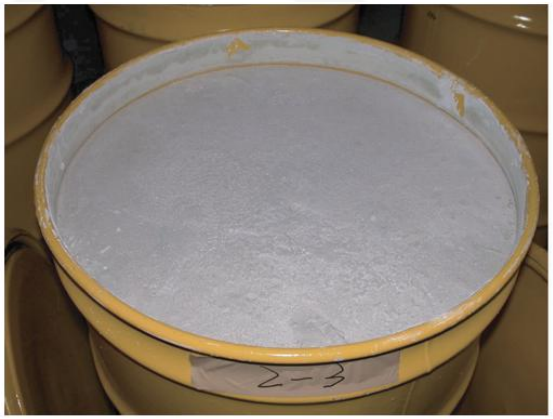
HIGH-EFFICIENCY SOLIDIFICATION TECHNOLOGY FOR PWR CONCENTRATE WASTE (PWRHEST)

High Volume Reduction Solidification System for Wet Wastes in Kuosheng Nuclear Power Plant



User friendiy Control System of the High Volume Solidification System

Control Panel of the High Volume Reduction Solidification System



Solidified Object Produced by Pilot Run of the High Volume Reduction Solidification System

HIGH-EFFICIENCY SOLIDIFICATION TECHNOLOGY FOR PWR CONCENTRATE WASTE (PWRHEST)

200 L Solidified Waste
Prepared by PWR HEST

Can meet strength criteria

Compressive strength:
> 30MPa

- ANY PARTICULAR NEEDS?

- FEVDI can provide custom made chemical products