P.O. Box 14000, Juno Beach, FL 33408-0420

FPL

JAN 2 5 2005

L-2004-232
10 CFR 20.1703(b)
10 CFR 20.1705

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: Florida Power and Light Company
St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251

FPL Energy Seabrook, LLC
Seabrook Station
Docket No. 50-443

**Request for Use of Higher Assigned Protection Factors Pursuant to 10 CFR 20.1705 with Use of French Designed Air Supplied Respirator Equipment**

Pursuant to the provision of 10 CFR 20.1705, "Application for use of higher assigned protection factors," Florida Power and Light Company (FPL), the licensee for the St. Lucie Nuclear Plant, Units 1 and 2, and the Turkey Point Nuclear Plant, Units 3 and 4, and FPL Energy Seabrook, LLC (FPL Energy Seabrook) the licensee for Seabrook Station hereby request authorization to use French designed air supplied respiratory equipment with an assigned protection factor.

Specifically, pursuant to 10 CFR 20.1705, FPL must obtain authorization from the Nuclear Regulatory Commission before using assigned protection factors in excess of those specified in Appendix A of 10 CFR 20. Appendix A to 10 CFR 20 specifies that an air-supplied suit may be used in continuous flow mode at a licensee's facility, but without using an assigned protection factor. Since these suits have no assigned protection factor, FPL/FPL Energy Seabrook are requesting authorization for their use as respiratory protection equipment with a protection factor of 5000 based on a fit factor of 50,000 per the manufacturer's testing results (attached). NIOSH approval for these air-supplied suits is not required per the provisions of 10 CFR 20, Appendix A, Footnote "g". Based upon easy egress from the suits, and their prohibited use in immediately dangerous to life or health (IDLH) environments, FPL/FPL Energy Seabrook does not plan to provide standby rescue persons when this equipment is used.

By letter dated March 4, 2003, as supplemented by letter dated May 1, 2003, Duke Energy Corporation requested authorization (1) to use French designed respiratory protection equipment that has not been tested and certified by the National Institute for Occupational Safety and Health, (2) to not provide standby rescue persons whenever this equipment is used, and (3) to take credit for an assigned protection factor of 2000 for this equipment. By letter dated June 30, 2003, the NRC staff concluded that authorization of the three requests were acceptable, and within the provisions of Title 10 of the Code of Federal Regulations, Part 20.

A001

The enclosed FPL/FPL Energy Seabrook request includes supporting documentation that is similar, to the information provided by Duke Energy Corporation in their request. The FPL/FPL Energy Seabrook request differs from the Duke Energy Corporation request in that FPL/FPL Energy Seabrook is requesting authorization to use French designed air supplied respiratory equipment with an assigned protection factor of 5000.

The enclosure provides the documentation supporting the FPL/FPL Energy Seabrook authorization requests. As described in the enclosure, use of the French designed air supplied respiratory equipment would improve worker safety in areas of airborne radioactivity and in areas with a high potential for facial/skin contamination from discrete radioactive particles.

FPL/FPL Energy Seabrook has identified the following respiratory protection program elements and controls associated with approval of this authorization request.

1. Prior to use, the Mururoa V4 F1 and V4 MTH2 suits will be integrated into FPL/FPL Energy Seabrook respiratory protection programs, using the information provided by the manufacturer.

2. Prior to use, new lesson plans will be developed to train workers on Mururoa's features, donning, use and removal, cautions and use of mouth strips and tear off strips for routine and emergency egress.

3. Prior to use, Health Physics personnel will be provided additional training for selection, approval, issue, equipment set-up, operation and maintenance instructions for the Mururoa suits.

4. Mururoa suits will not be used in IDLH environments.

Florida Power & Light Company would like to begin using the Mururoa V4 F4 and V4 MTH2 suits during the April 2005, Turkey Point Unit 4 refueling outage. Therefore, FPL/FPL Energy Seabrook is requesting the subject authorization by April 1, 2005.

Should there be any questions, please contact Joe Danek at (561) 694-4213

Sincerely yours,

J. A. Stall
Senior Vice President, Nuclear and
Chief Nuclear Officer

Enclosure

# ENCLOSURE

# APPROVAL REQUEST

# 10 CFR 20.1705 "APPLICATION FOR USE OF HIGHER ASSIGNED PROTECTION FACTORS"

# ENCLOSURE

## APPROVAL REQUEST

## 10 CFR 20.1705 "APPLICATION FOR USE OF HIGHER ASSIGNED PROTECTION FACTORS"

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2. European Standard EN 1073-1 Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination.
3. Protection Factor determined during fit test exercises for V4 F1
4. Certificate No. 0073/197/162/12/97/0028 for Mururoa V4 F1 issued by the Institute for Nuclear Protection and Security
5. Donning and Removal Instructions for Mururoa V4 F1
6. Certificate No. 0073/197/162/01/96/0001 issued for Mururoa V4 MTH2 by the Institute for Nuclear Protection and Security
7. Protection Factor determined during fit test exercises for V4 MTH2
8. Donning and Removal Instructions for Mururoa V4 MTH2

# 1.0 INTRODUCTION

## 1.1 PURPOSE

Florida Power & Light Company (FPL) and FPL Energy Seabrook, request NRC authorization (1) to use and take credit for, the protection provided by two French designed air supplied respiratory protection suits during normal (non-emergency) operation, and (2) to take credit for an assigned protection factor of 5000.

The suits are manufactured by Delta Protection, 30200 Bagnols su C'eze, France, and are identified as Mururoa V4 F1 and Mururoa V4 MTH2. Both models are single-use suits (a suit that is disposed of after one use). Florida Power & Light and FPL Energy Seabrook, propose to use the suits in the approved configurations relative to the suits' form, fit, and function.

This enclosure provides evidence that the material and performance characteristics of the Mururoa suits are capable of providing the proposed degree of protection under anticipated conditions of use. This is demonstrated on the basis of reliable test information.

## 1.2 REGULATORY REQUIREMENTS

### 1.2.1 Requirements of 10 CRF 20.1705, and Appendix A to Part 20

The following regulatory requirements are relevant to this request.

> 10 CFR 20.1705, Application for Use of Higher Assigned Protection Factors, requires that the licensee shall obtain authorization from the Commission before using assigned protection factors in excess of those specified in Appendix A to Part 20. The Commission may authorize a licensee to use higher assigned protection factors on receipt of an application that –
>
> (a) Describes the situation for which a need exists for higher protection factors; and
>
> (b) Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.
>
> Appendix A to Part 20, Assigned Protection Factors, lists as item II, Atmosphere supplying respirators (particulate, gases and vapors), "Suit" in a continuous flow operating mode, with reference to Note "g". Note "g" states: "No NIOSH approval schedule is currently available for atmosphere supplying suits. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements, with the exception of fit testing, are met (i.e., 10 CFR 20.1703)."

Therefore, based on the above requirements, FPL and FPL Energy Seabrook request authorization to use the Mururoa respiratory protection suits and to take credit for an a assigned protection factor of 5000 for this equipment.

## 2.0 TECHNICAL JUSTIFICATION

### 2.1 SCOPE

#### 2.1.1 Situation for Which a Need Exists for Higher Protection Factors

Florida Power & Light and FPL Energy Seabrook currently use bubblehoods for jobs involving high potential for skin contamination from discrete radioactive particles and to prevent intake of airborne contaminants. Because the bubblehood covers only the face and torso, workers have to wear additional protective clothing, two pairs of gloves, rubber shoes and cotton booties and tape for sealing. Chances of cross contamination during undressing/exit from contaminated areas are high. The Mururoa suits offer a better alternative (with their unitized construction and ease of removal) and will protect the worker much better against facial/skin contamination and airborne radioactivity. Approval of a protection factor of 5000 for the Mururoa suits would allow use of the Mururoa suits in FPL's and FPL Energy Seabrook's efforts to control contamination incidents and prevent intakes during operational activities at St. Lucie Units 1 and 2, Turkey Point Units 3 and 4, and Seabrook Station.

#### 2.1.2 Demonstration that the Respiratory Protection Equipment Provides these Higher Protection Factors under the Proposed Conditions of Use.

FPL reviewed the following documents from Delta Protection, France:

(a) Technical information on Mururoa V4 model ventilated suits (Attachment 1)
(b) European Standard EN 1073-1 for ventilated protective clothing (Attachment 2)
(c) Protection Factor determined during fit test exercises for V4 F1 (Attachment 3)
(d) Certificate No. 0073/197/162/12/97/0028 for Mururoa V4 F1 issued by the Institute for Nuclear Protection and Security (Attachment 4)
(e) Donning and Removal Instructions for Mururoa V4 F1 (Attachment 5)
(f) Certificate No. 0073/197/162/01/96/0001 issued for Mururoa V4 MTH2 by the Institute for Nuclear Protection and Security (Attachment 6)
(g) Protection Factor determined during fit test exercises for V4 MTH2 (Attachment 7)
(h) Donning and Removal Instructions for Mururoa V4 MTH2 (Attachment 8)

The European Standard (Attachment 2) requires single-use suit materials to be tested for resistance to abrasion, puncture, tear and flammability, strength of seams, joins and assemblies, damage resistance of exhaust valves, designed flow rates for pressure range of supplied air, noise level and quality of the visor. The protection factor (average inward leakage or fit factor) is measured according to draft prEN 941-1 (Annex A). According to the testing standard, test subjects perform standard exercises inside a chamber filled with a test agent (Sodium Chloride). Inward leakage is then calculated during an exercise regimen lasting approximately 20 minutes. Operating parameters are set to manufacturer's instructions. Standard exercises include walking on a treadmill at 2 mph (3 minutes), moving arms up and down above the head while looking upward (3 minutes) and squatting continuously (3 minutes). To ensure worker's comfort, two additional practical exercises - walking at 2 mph (5 minutes)

and loading a bucket with wood chips from the base of a hopper and emptying it into the opening on top (15 minutes) - should be performed by two workers at specified air flow rates.

Certificate No. 0073/197/162/12/97/0028 (Attachment 4) states that the Mururoa V4 F1 passed in all categories tested and provided a protection factor greater than 50,000. Certificate No. 0073/197/162/01/96/0001 (Attachment 6) states that the Mururoa V4 MTH2 passed in all categories tested and provided a protection factor greater than 50,000. Please note that the term 'protection factor' used in the European Standard is equivalent to the 'fit factor' used in the United States and is not the same as the Assigned Protection Factor used in 10 CFR 20. Based on FPL and FPL Energy Seabrook review of the manufacturer's documentation, the Mururoa V4 F1 and V4 MTH2 suits represent a better design than the currently approved "bubble hood" and "rain suit" combination and provide better worker protection with data supporting an assigned protection factor of 5000.

The Mururoa suit's design does not permit its use in an immediately dangerous to life and health (IDLH) atmosphere. Florida Power & Light Company and FPL Energy Seabrook, plan to use these suits for protection against radioactive particulate contamination only. The Mururoa suit is also not designed for use with any personal cooling units such as a Vortex tube, but can be used with a cooling vest supplied by the manufacturer, if desired.

## 2.2 DISCUSSION

Evidence that the material and performance characteristics of the Mururoa V4 F1 and V4 MTH2 encapsulated single use suits are capable of providing the proposed degree of protection under anticipated conditions of use is provided in Attachments 1 through 8. A summary of material and performance characteristics follows.

### 2.2.1 Suit Construction

The Mururoa suit models V4 F1 and V4 MTH2 meet ISO 8194, European Standard EN 1073-1, and the manufacturer is ISO 9001 certified. The manufacturer indicates that approximately 60,000 Mururoa garments/suits are used by European Nuclear Power plants each year.

The Mururoa single use suits have the following desirable features that are not available in the "bubblehoods" and "rain suits" manufactured in the United States:

1) One piece single use suit that includes welded gloves and booties with tie straps
2) Fireproof (up to 65 deg C)
3) Made of PVC or Ethyfuge with reinforced elbows, knees and crotch areas.
4) Dual zippers - metal zipper inside and plastic zipper outside
5) Helmet made of clear PVC material that provides distortion-free vision and large enough for wearing a headset
6) Welded sleeve to insert communication cable
7) A removable strip near the mouth that could be used for emergency breathing in case of loss of supplied air

8) An egress strip stretching from the left arm, over the head, to the right arm that is used for undressing and for self-rescue in an emergency, such as loss of supplied air
9) An air intake located at the waist with a built-in regulator that can adjust, but not block, air flow
10) Two exhaust valves that provide ventilation and also protect from overpressure
11) Very low noise level at maximum air flow
12) Air flow to hands, feet, face and chest

Air hoses of any length can be used, but air shall be supplied to the Mururoa suit (model V4 F1) at 85 psig measured at the inlet. A regulator at the inlet can adjust the air flow from 43 CFM maximum to 19 CFM at the minimum. To ensure user safety, the regulator cannot shut off the air supply. Noise level is kept between 76 dB at maximum air flow to 58 dB at minimum air flow. Air flows through manifolds to the chest, hands and feet. There are two exhaust vents on the back - one behind the neck and one at the lower back. The exhaust vents have patented magnetic seals to prevent any aspiration of contaminants if supplied air is lost. The suit is made of non-flammable PVC, but should not be brought in direct contact with any material colder than 41 deg F or hotter than 140 deg F. Open flames or sparks could melt or perforate the suit. There is a shelf-life of 3 years for this suit and storage between 32 deg F and 140 deg F in original packing is required by manufacturer. The Mururoa is approved for use with 16 different fittings in Europe and can be fitted with Schrader, Foster, CEJN, or Hansen fittings used at St. Lucie Units 1 and 2, Turkey Point Units 3 and 4 and the Seabrook Station.

The Mururoa suit model V4 MTH2 is made of Ethyfuge material which is fully incinerable. This material is more flexible than the PVC used in V4 F1. It is constructed the same way as the V4 F1. Breathing air is required at about the same pressure (85 psig). The regulator can adjust air flow between 19 CFM and 43 CFM. Noise level varies from 58 dB at minimum air flow to 76 dB at maximum air flow. There are two additional air vents near the chin for cooling the face. The suit is also fire-retardant and can be used in ambient temperatures up to 140 deg F. Storage requirements are the same as the V4 F1. These suits are also available with multiple fittings.

2.2.2 Safety Features of V4 F1 and V4 MTH2 Models

Both Mururoa suit models are light-weight (2.5 lbs), made of fire-retardant material and can be used in temperatures up to 140 deg F. Contact with open flames or grinding/welding sparks is prohibited. Built-in gloves, booties with binding ties, reinforced elbows, knees and crotch protect against accidental tear, puncture and cracking. A transparent helmet with 6" X 8" clear face plate provides distortion-free view. Dual magnetic ventilation valves provide needed ventilation and relief of excess pressure in case the suit is squeezed/pinched unexpectedly. Noise level at maximum air flow is less than 80 dB. Length of air hose supplying Grade D breathing air is not stipulated, but the pressure of air at the inlet is required to be 85 psig for V4 F1 and for V4 MTH2. Air flow can be adjusted by the user for his/her comfort, but cannot be shut off. In case of loss of air, the user can remove the mouth strip and move the opening close to his face, or enlarge the opening, to breathe outside air. Alternately, the user can pull the escape strip from either forearm, over the head and towards the other forearm, and rip the suit in two halves. This escape strip is normally used for egress from the suit when the work activity has been completed.

### 2.2.3 Implementation

Florida Power & Light Company and FPL Energy Seabrook have respiratory protection programs in full compliance with 10 CFR 20. The Mururoa V4 F1 and V4 MTH2 suits will be integrated into FPL's respiratory program using the information provided by the manufacturer. New lesson plans will be developed to train workers on Mururoa's features, donning, use and removal, cautions, and use of mouth strip and tear off strips for routine and emergency egress. Health Physics personnel will be provided additional training on selection, approval, issue, equipment set-up, operation and maintenance instructions for the Mururoa suit.

The Mururoa suit's safety features, namely the tear-off mouth strip and the emergency tear-off strip, make it unnecessary for any standby rescue person. However, workers wearing air-supplied suits are typically under continuous surveillance by Health Physics technicians using remote video monitoring, or under direct Health Physics surveillance at the job location due to radiological conditions. Additionally, in many cases, workers are in direct contact with Health Physics and Steam Generator support personnel via audio headsets. The ability to eliminate the standby rescue person is also an ALARA consideration since the work areas where air-supplied suits are used are typically areas with higher radiation and contamination levels.

Steam Generator platform work, reactor head work, cavity decontamination, and equipment decontamination are specifically targeted for the use of the Mururoa suit. Florida Power & Light and FPL Energy Seabrook will use the Condition Report (CR) process to document any unexpected problems and track corrective actions taken. Problems associated with the suits will be communicated to the manufacturer to ensure that operating experience is shared with other users. A relationship with the manufacturer will also be developed that allows operating experience from other users to be incorporated into FPL and FPL Energy Seabrook, processes. Florida Power & Light and FPL Energy Seabrook, will be pleased to share this experience with the NRC and other utilities that may be interested in the Mururoa suit. Delta Protection has in place a vendor-user alert system so as to report any deviations, or deficiencies with the product and manufacturing process should they arise. The manufacturer is subjected to checks from the IPSN to insure the product has no risk of injury to the user. A second organization called ASQUAL performs annual inspections of the factory to certify that the product manufactured is of the same quality approved by the IPSN Notified Body. Several destructive/non-destructive tests are performed by the manufacturer for each order received from clients. Any defects reported by clients, investigations and corrective actions are documented. Customers are notified of any problems and products are recalled if necessary. This information is made available to ASQUAL for their annual inspections.

## 2.3 CONCLUSION

Florida Power & Light and FPL Energy Seabrook, request authorization, pursuant to10 CFR 20.1705, to use French designed respiratory equipment with an assigned protection factor of 5000. Based on reliable test information discussed earlier in this enclosure, FPL and FPL Energy Seabrook have determined that the Mururoa suits offer a safer and more efficient means to protect workers in areas of high radiological contamination and in areas where there is a potential for airborne contamination. Pursuant to 10CFR20.1705, FPL and FPL Energy

Seabrook are requesting authorization to use an assigned protection factor of 5000 with the Mururoa V4 F1 and V4 MTH2 respiratory protection suits. Testing and associated manufacturer's documentation has shown that these suits provide design and protection considerations that support the requested assigned protection factor.

## 2.4 REFERENCES


- 10 CFR 20.1703, Use of individual respiratory protection equipment
- 10 CFR 20.1705, Application for use of high assigned protection factors
- Appendix A to 10 CFR 20, Assigned Protection Factors for Respirators
- Regulatory Guide 8.15 Rev. 1, Acceptable Programs for Respiratory Protection
- NUREG-0041, Manual of Respiratory Protection Against Airborne Radioactive Materials
- European Standard EN 1073-1, Protective Clothing Against Radioactive Contamination (Attachment 2)
- EC Type Examination Certificate No. 0073/197/162/12/97/0028 for the Mururoa V4 F1 suit dated December 10, 1997 (Attachment 4)
- EC Type Examination Certificate No. 0073/197/162/12/96/0001 for the Mururoa V4 MTH2 suit dated January 10, 1996 (Attachment 6)

# ATTACHMENT 1

# MURUROA V4 FULLY ENCLOSED SUIT GENERAL DESCRIPTION

(NOTE: Attachment 1 contains 5 pages. The page numbering system for Attachment 1 initially showed 4 pages and a pen was used to mark through the incorrect page number to show that there are 5 pages)

# MURUROA SUIT

The Mururoa suit is a single use garment designed to be used in radioactively contaminated environments. It has been widely used in western European Nuclear Power Plants for more than 20 years, without any major problem (the French state company: Electricité de France use 60,000 garments each year).

The Mururoa suit is a fully enclosed PVC plastic, supplied-air and pressurized suit, that offers excellent protection factor ( ~100,000) against any solid, liquid, or gas pollutant, minimizing discomfort and heat stress and increasing the worker's efficiency.

The Mururoa suit is C.E. approved and complies with CE standard EN:1073-1 "Protective clothing against Radioactive Contamination"
It also fulfils the requirements of the I.S.O. 8194 standard "Radiation Protection-Clothing for protection against Radioactive contamination-Design selection ,testing and use"

## VENTILATION / EXHAUST

In the supplied-air Mururoa suit, the ventilation system is composed of

- An airflow control valve, preset to a minimum flow of 250 litres/minute (9 CFM) at 3 bar (42 PSIG), located on the right hip and covered with a protection flap. This flow can be adjusted, from 250 to 1150 litres (9 CFM to 41 CFM) per minute. 1150 litres is obtained with the tap fully opened at the feeding pressure of 6 bar (85 PSIG) (refer to graph in annex 11).

- A silencer bag which attenuates the noise level less than 58 dBa at 250 litres/minutes to 76 dBa at 1150 litres/minute.

- A manifold system welded to the suit and distributing the air to the helmet, the legs and the arms.

- An exhaust by two world patented valves placed in the helmet and in the back. These valves ensure a remarkable airtight seal in case of accidental air-feed cut off, or when putting the suit in under pressure through abrupt movements. The valves regulate the overpressure in the garment between 3 mbar (0.042 PSIG) and 10 mbar (0. 142 PSIG) for supply air pressure between 3 bar (42 PSIG) and 6 bar (85 PSIG)

- The benefits of this system are

  - High heat removal through superior airflow
  - Non irritating diffuse ventilation
  - Resistance free breathing
  - High level of comfort for long and strenuous jobs in contaminated areas
  - Very low noise level

## DESIGN CHARACTERISTICS

- One piece PVC, fire proof suit. (Thickness 20/100mm for technical data concerning the material, refer Annex I of this document)
- Welded PVC gloves
- Incorporated overboots with strengthened sole
- Binding ties on the overboots
- Reinforced elbows, knees and crotch
- Dual zipper system: - metal zipper for mechanical strength
  - PVC zipper for air and gas tightness (0.30 PVC thickness)
- Supple transparent PVC helmet, fitted with a transparent distortion free, PVC face plate 6"x 8" giving almost the same optical quality as glass.
- Quick release strip from forearm, overhead to forearm, for easy removal. This is used both for undressing or emergency egress. (Emergency egress takes less than 3 seconds).
- Quick release strip for access to the mouth.
- Welded sleeve for communication cable.

## GENERALCONSIDERATIONS

THE MURUROA SUIT IS AVAILABLE IN SIX SIZES

| | | | | | | |
|---|---|---|---|---|---|---|
| Size 0 | 1,55 m | → | 1,62 meter | 5 feet I inch | → | 5 feet 4 inches |
| Size 1 | 1,60 | → | 1,68 meter | 5'3" | → | 5'6" |
| Size 2 | 1,68 | → | 1,74 meter | 5'6" | → | 5'8" |
| Size 3 | 1,74 | → | 1,82 meter | 5'8" | → | 6'0" |
| Size 4 | 1,82 | → | 1,92 meter | 6'0" | → | 6'3" |
| Size 5 | 1,92 | → | 2,05 meter | 6'3" | → | 6'8" |

But if any individual selects a suit size different from the recommended size, the operating and safety characteristics will not change.

| | |
|---|---|
| WEIGHT | 1200 grams (2.64 LBS) |
| FEEDING PRESSURE | 6 bar (85 PSIG) |
| FLOW | 450 up to 1150 Lit/minute (16 - 41 CFM) |

STORAGE

- The suit should be used by the third year from the date of manufacture.
- It must be stored in its original packaging.
- The storage temperature has to stay between 0°C and 60°C (32°F - 140°F)
- If the storage temperature was below 5°C (41°F) the suit must be stored approximately 3 hours at a room temperature until the suit become flexible.
- The usage temperature range + 5° C and + 55°C (41° - 13l°F) depends on air fed temperature

## MATERIAL PROPERTIES

Technical characteristic of PVC material 20/100 mm using French standards, which would correspond to ANSI standards.

| *Characteristic* | *Standards* | *Results* | | *Units* |
|---|---|---|---|---|
| Density | NFT 51063 | 1.38 | | gm/cm3 |
| Traction Resistance | NFT 54102 | ≥ 143 | | N/cm² |
| Stretch before tear | NFT 54102 | ≥ 178 | | % |
| Tear resistance | NFT 46007 | ≥ 45 | | N/cm² |
| Weld resistance than material resistance | NFT 54122 | Peel 50 | Tear 65 | % |
| Resistance to cold | NFT 51102 | -10 | | °C |
| Vapour permeability | NFH 00030 | 34.1 | | g/m²/24h |
| Volatility on activated charcoal | NFT 51167 | ≤ 6 | | % |
| Spark perforation | NFC 26225 | 9.2 | | KV |

# ATTACHMENT 2

# EUROPEAN STANDARD EN 1073-1

## Protective Clothing Against Radioactive Contamination

### PART 1: Requirements and test methods for ventilated protective clothing against particulate contamination

# EUROPEAN STANDARD
# NORME EUROPEENNE
# EUROPEAÏSCHE NORM

**EN 1073-1**

January 1998

ICS 13.280; 13.340.10

Descriptors: Personal protective equipment, clothing, radioactive contamination.

**English version**

## Protective clothing against radioactive contamination

Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination

Vêtements de protection contre la contamination radioactive - Partie 1: Exigences et méthodes d'essai des vêtements contre la contamination radioactive sous forme de particules

Schutzkleidung gegen radioaktive Kontamination -Teil 1: Anforderungen und Priifverfahren fur beliiftete Schutzkieidung gegen radioaktive Kontamination durch feste Partikel

This European Standard was approved by CEN on 1997-11-23. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

# CEN

European Committee for Standardization

Comite Europeen de Normalisation

Europaisches Komitee fur Normung

**Central Secretariat: rue de Stassart 36, B-1050 Brussels**

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Ref. No. EN 1073-1 : 1998 E

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## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

The annex A is normative and contains the activity sequence for the testing of the protection factor.

Further parts of this standard will deal with requirements and test methods for unventilated protective clothing and protection against liquids and gases.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## 1 Scope

This European Standard specifies the requirements and test methods for ventilated protective clothing protecting the wearer against particulate radioactive contamination.

This European Standard does not apply for the protection against ionizing radiation and the protection of patients against contamination with radioactive substances by diagnostical and/or therapeutical measures.

## 2 Normative references

This European standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 146
Respiratory protective devices - Powered filtering devices incorporating helmets or hoods - Requirements, testing, marking

EN 270
Respiratory protective devices - Compressed air line breathing apparatus incorporating a hood - Requirements, testing, marking

EN 340
Protective clothing - General requirements

EN 530
Abrasion resistance of protective clothing material - Test methods

EN 863
Protective clothing - Mechanical properties - Test method: Puncture resistance

prEN 943-1
Protective clothing for use against liquid and gaseous chemicals, including liquid aerosols and solid particles - Performance requirements for ventilated and non-ventilated "gas-tight" (Type 1) and "non-gas-tight" (Type 2) protective clothing

EN 1146
Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking

EN 25978
Rubber- or plastics- coated fabrics - Determination of blocking resistance (ISO 5978 : 1990)

EN 29073-4
Textiles - Test methods for nonwovens - Part 4: Determination of tear resistance

ISO 5082 : 1982
Textiles - woven fabrics - Determination of breaking strength - Grab method

ISO 7854
Rubber- or plastics-coated fabrics - Determination of resistance to damage by flexing

## 3 Definitions

For the purposes of this standard, the following definitions apply:

### 3.1 Protective clothing against radioactive contamination

Protective clothing intended to provide protection to the skin and if required to the respiratory tract against radioactive contamination.

### 3.2 Ventilated protective clothing (against particulate radioactive contamination)

Protective clothing which is supplied with breathable air ensuring internal ventilation and overpressure. This protective clothing provides protection against particulate radioactive contamination for the respiratory tract and the whole body.

### 3.3 Nominal protection factor (100: Inward leakage (IL))

The ratio of the concentration of contaminant in the ambient atmosphere to the concentration of the contaminant in the suit. The concentrations taken into account are the average concentrations recorded during a standardized test.

### 3.4 Paniculate radioactive contamination

Presence of radioactive substances in or on a material or in a place where they are undesirable or could be harmful.

### 3.5 Seam

A permanent fastening between two or more pieces of protective clothing material.

### 3.6 Assemblage

A permanent fastening between two or more different garments, or between protective clothing and accessories, obtained, for example by sewing, welding, vulcanising, gluing.

### 3.7 Join

A non-permanent fastening between two different garments, or between protective clothing and accessories.

### 3.8 Closure

A device, for example, zipper, "touch and close" fastener, etc., to close openings for donning or removing the protective clothing.

## 4 Requirements

### 4.1 Design

4.1.1 Protective clothing against radioactive contamination shall comply with the general requirements specified in EN 340.
4.1.2 The design of the protective clothing shall be such that the protective clothing is straightforward to put on and take off, and to minimize the risk of contamination. Testing according to "practical performance test" (see 5.2).
4.1.3 The clothing can be designed for single or multiple use.
4.1.4 The ventilated protective clothing (see 3.2} may consist of one or several parts. The clothing may be fitted with a respiratory protective device to enable the wearer to breath in case of failure of the primary air supply.

### 4.2 Materials

The materials used for protective clothing against particulate radioactive contamination shall meet the requirements according to table 1 after the pretreatment in accordance with 5.1.1 and after the conditioning according to 5.1.2.

**Table 1: Requirements for the materials**

| Requirement | Classification | Test according to | Applicable for reusable materials | Applicable for single use materials |
|---|---|---|---|---|
| Abrasion resistance | 6 > 2000 Cycles<br>5 > 1 500 Cycles<br>4 > 1000 Cycles<br>3 > 500 Cycles<br>2 > 100 Cycles<br>1 > 10 Cycles | EN 530, Method 2 00 abrasive paper according to prEN 943-1 and 9 kPa downward pressure | yes | yes |
| Flex cracking resistance | 6 > 100000 Cycles<br>5 > 40000 Cycles<br>4 > 1 5000 Cycles<br>3 > 5000 Cycles<br>2 > 2500 Cycles<br>1 > 1000 Cycles | ISO 7854 Method B | yes | no |
| Puncture resistance | 3 > 100 N<br>2 > 50 N<br>1 > 10 N | EN 863 | yes | yes |
| Resistance to blocking (see note 1) | 2 no blocking<br>1 blocking | EN 25978 | yes | no |
| Tear resistance | 6 > 150 N<br>5 > 80 N<br>4 > 40 N<br>3 > 20 N<br>2 > 10 N<br>1 > 2 N | EN 29073-4 | yes | yes |
| Flammability of materials, visor and ancillary parts | Shall not continue to burn | EN 1146 (single burner test) | yes | yes |

NOTE 1: Uncoated materials shall not be tested against resistance to blocking. The test report shall be marked "Not tested against....."
NOTE 2: If protection against hazardous chemicals is required then testing has to be carried out according to the relevant chemical standards.

### 4.3 Nominal protection factor (100:IL)

Ventilated protective clothing shall be classified according to table 2. Testing according to 5.4 with the necessary activity sequence according to annex A, at the minimum design air flow rate.

**Table 2: Leakage**

| Class | Maximum value of mean inward leakage into the hood during exercise of | | Nominal protection factor |
|---|---|---|---|
| | One activity % | All activities % | |
| 5 | 0,004 | 0,002 | 50000 |
| 4 | 0,01 | 0,005 | 20000 |
| 3 | 0,02 | 0,01 | 10000 |
| 2 | 0,04 | 0,02 | 5000 |
| 1 | 0,10 | 0,05 | 2000 |
| NOTE 1: Maximum value is calculated as the average performance over all test sequences. NOTE 2: Nominal protection factor is the reciprocal of the IL obtained during all activities (100 : IL) | | | |

### 4.4 Seam strength, Joins and Assemblages

4.4.1 Seam strength

A sample of each type of straight seam construction shall be tested in accordance with A.2 of ISO 5082 : 1982 (Constant-rate-of-traverse). Three specimens of each type of seam shall be tested and the mean of each set of three samples calculated. The garment seam performance shall be classified according to the levels of performance given in table 3 using the lowest result, i.e. the weakest seam type.

NOTE: The test method described in ISO 5082 : 1982 is only applicable to straight seams joining two pieces of material.

**Table 3: Classification of seam strength**

| Class | Seam strength N |
|---|---|
| 5 | >300 |
| 4 | >125 |
| 3 | > 75 |
| 2 | > 50 |
| 1 | > 30 |

4.4.2 Joins and assemblages

The joins and assemblages between the suit and detachable parts e.g. between gloves and sleeves, boots and trouser legs, shall be tested in accordance with 5.5 and withstand a pull of 100 N.

### 4.5 Visor

The visor shall comply with table 4. Where antifogging compounds are used or specified by the manufacturer they shall not have an adverse affect on the health of the wearer, or on the clothing.

**Table 4: Requirements for the visor**

| Properties of the visor | Requirement | Testing |
|---|---|---|
| Distortion of vision | the loss of sight shall not exceed two scales on the optometrical chart | to read letters on a chart at a distance of 5 m during the practical performance test according to 5.2 |
| Mechanical strength | shall not be visibly damaged in such a way as to be likely to affect the performance of the suit system | according to EN 146 |

### 4.6 Air supply system

Couplings and connections shall comply with EN 270.

The connection between the compressed air supply tube and the suit, including attachments, threaded parts, belt or other parts, or means of stabilising the suit to the body shall withstand a 250 N pull when tested according to 5.5 .

NOTE: The test should be performed before the inward leakage test.

### 4.7 Breathing hose

The breathing hose shall comply with the requirements of EN 270.

### 4.8 Air flow rate

Two suit systems shall be tested, one of which has to be preconditioned as specified in 5.1.4. When tested the air flow rate into the suit system shall not be less than the manufacturers' minimum design flow rate. The maximum flow rate shall not exceed the maximum as stated by the manufacturer. Test in accordance with 5.3

The flow rate and the distribution of the air into the suit system shall not cause distress to the wearer by local cooling. The heat stress has to be considered. Test in accordance with 5.2.

### 4.9 Air flow rate warning device

If an audible warning device is incorporated in the suit system it shall comply to EN 270, except for the sound pressure level which may be in the range 85dB(A) to 90 dB(A) when measured at the ears of the wearer. The frequency range of the warning device shall be between 2 000 Hz to 4 000 Hz.

Five warning devices shall be tested, one of which has to be preconditioned as specified in 5.1.4. Testing according to EN 270.

### 4.10 Supply valve

If a variable continous flow valve is fitted, it shall comply to EN 270. The valve shall permit to adjust the air flow rate in the range from the minimum to the maximum as specified in 4.8. It shall not be possible to close the valve to restrict the air flow below the minimum design air flow rate.

### 4.11 Exhaust devices

The suit shall be provided with exhaust devices which shall continue to work correctly after the testing of the pressure in the suit (see 4.1 2), during the practical performance test (see 5.2) and during the determination of the protection factor (see 5.4). Testing in accordance with 5.6.

### 4.12 Pressure in the suit

The overpressure shall not exceed 1 000 Pa mean and 2 000 Pa peak. A positive pressure shall be maintained. Testing with the maximum air flow rate during the activity sequence as specified in Annex A.

### 4.13 Carbon dioxide content of the inhalation air

The carbon dioxide content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1,0 % (by volume), tested according to EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 5.1.1.

### 4.14 Noise associated with the air supply to the suit

The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum manufacturers' design flow rate. Testing in accordance with EN 270. Two suits shall be tested, one of which has to be pretreated as specified in 5.1.1.

# 5 Test methods

## 5.1 Test preparations

### 5.1.1 Pretreatment

When the clothing is intended to be reusable the requirements for the materials or the complete clothing shall be proved after five cycles of cleaning and disinfection according to the manufacturer's instructions for use before testing.

### 5.1.2 Conditioning

All material samples shall be conditioned by storage at (20 ± 2) 'C and (65 ± 5) % relative humidity for at least 24 h. Start each of the tests as specified in 5.1.3 and 5.1.4, within 5 min after removal from the conditioning atmosphere.

### 5.1.3 Visual inspection

A visual inspection shall be carried out by the test house prior to the laboratory or the practical performance test. This may entail a certain amount of dismantling of the components of the protective clothing in accordance with the manufacturer's information for maintenance.

### 5.1.4 Preconditioning for the practical performance test

If the manufacturer does not state the preconditioning atmosphere for the practical performance test, the complete clothing shall be exposed:

a) for 4 h to a temperature of (-30 ± 3) "C and allowed to return to ambient conditions, followed by

b) for 4 h to an atmosphere of (60 ± 3) "C at 95 % relative humidity. It shall then be allowed to return to ambient temperature.

## 5.2 Practical performance test

### 5.2.1 General

The tests shall be carried out by two test persons at (20 ± 5) "C and a relative humidity of less than 60 %. The test temperature and humidity shall be recorded. The background noise shall not be greater than 75 dB(A).

The test persons shall be selected who are familiar with using such or similar protective clothing. The persons will be drawn from those people certified as fit to do so by the medical officer. The necessity of a medical examination before or supervision during the tests shall be at the testing officers discretion.

Prior to the test there shall be an examination that the suit is in working-condition and that it can be used without danger. If more than one size of clothing is manufactured the subjects are asked to select the appropriate size. Ensure that the air supply is within the specified parameters. Two suits shall be tested, each being tested on one test person.

After fitting the suit each test person is asked "Does the suit fit?". If the answer is "Yes", continue the test. If the answer is "No", replace the test person or the suit.

### 5.2.2 Procedure

During the test the following activities shall be done in simulation of the practical use of the suit:

a) the test shall be completed within a total working time of 20 min

b) walking on the level with regular rate of 5 km/h for 5 min

c) filling a small basket (see figure 1, approximate volume 8 l) with 12 mm chippings (e.g. limestone chippings) or other suitable material from a hopper which stands 1,5 m high and has an opening at the bottom to allow the contents to be shovelled out and a further opening at the top where the chippings may be returned. The person stoops or kneels as he wishes and fills the basket with chippings. He then lifts the basket and empties the contents back into the hopper. This shall be repeated 1 5 to 20 times in 10 min .

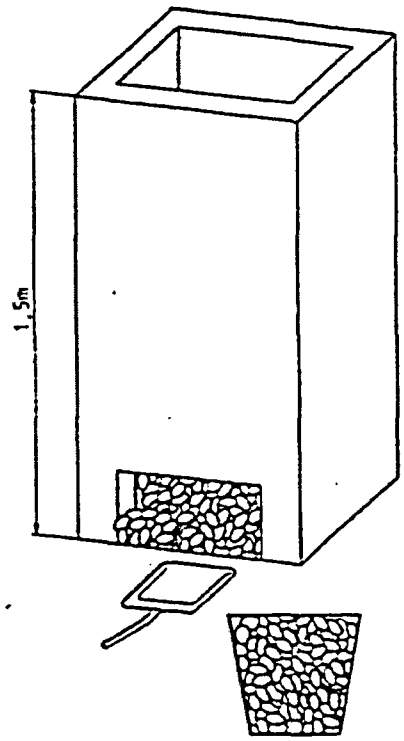



**Figure 1: Hopper and basket**

### 5.2.3 Information to be recorded

During the practical performance test the clothing shall be subjectively assessed by the wearer and the following shall be recorded:

a) harness comfort (see 5.6);
b) security of fastening and couplings;
c) accessibility of controls and pressure gauge (if fitted);
d) clarity and field of vision from the facepiece and/or visor;
e) clothing comfort;
f) ease of speech transmission;
g) any other comments volunteered by the wearer.

### 5.3 Measurement of minimum and maximum air flow rate

Connect the ends of the distribution system collectively to a suitable measuring device. Record the maximum air flow delivered at the manufacturers' specified air supply, if a control valve is fitted, record the maximum delivered air flow and the minimum delivered air flow.

The value of minimum and maximum air flow rate shall be determined under the condition of exercise 6 of Annex A (person standing still).

### 5.4 Determination of the protection factor

The protection factor shall be determined in accordance with prEN 943-1. Sodium chloride test method shall be used. Activity sequences for testing are given in Annex A of this standard.

The determination has to be done at the minimum design air flow rate (see 4.8).

On two test subjects four new suits shall be tested. Two suits per test subject.

For each individual test calculate the arithmetic mean over the time period. Calculate the percentage inward leakage (IL) as follows: :-

$$IL = \frac{C_2 \times 100\%}{C_1}$$

where:

$C_1$ is the challenge concentration in the test chamber,
$C_2$ is the mean concentration in the breathing zone for each exercise. For classification according to table 2, the average value for the four suits shall be taken.

### 5.5 Join and assemblage pull test

Assemble the means of attachment according to the manufacturers' information. If the assembled item (e.g. glove or boot) is itself not strong enough to apply the required pull substitute an item that is. Securely attach one part to a fixed clamp. Apply the required force longitudinally. Record at which force it parts or state that at the required force it was still complete.

### 5.6 Exhaust device pull test

Mount the suit on to a dummy torso which can be adjusted so that the load can be applied axialiy to the exhaust device. A system of retaining straps or bands is fitted over the suit around the exhaust device so that the load is applied as directly as possible to the fitting of the exhaust device in the suit.

Exert a force of (50 ± 2,5) N to the exhaust device and hold for 10 s. Repeat 10 times.

Examine the exhaust device for signs of damage or failure.

## 6 Marking

The marking shall comply with the specifications of EN 340 with the pictogram as given in figure 2.

The level of performance of the inward leakage (IL) shall be marked as:

IL : class x (x = class number according to table 2).

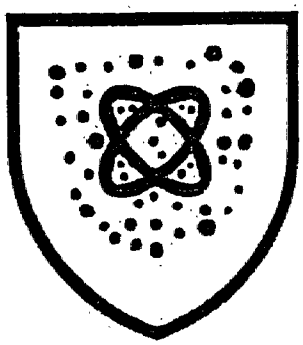


Figure 2: Pictogram

## 7 Information supplied by the manufacturer

The information supplied shall be at least in the official language(s) of the country or region of application. The manufacturers' information shall comply with the specifications of EN 340. The following information shall be supplied additionally:

- instructions for donning, using, fitting, removing and storing;
- application, limitations of use (classification, temperature range etc.);
- tests to be carried out by the wearer before use (if required);
- maintenance and cleaning and decontamination by e.g. showering (if required).

The manufacturers shall specify the required supply pressure and flow range necessary to maintain protection.

Warnings (if appropriate) shall be given against problems likely to be encountered, as e.g. heat stress, depending on the air flow rate, work load, environmental atmosphere etc.

## Annex A (normative)

### Activity sequence for the testing of the protection factor

**Table A.1: Activity sequence for the testing of the protection factor**

| No | Activity sequence for the testing | Time of activities min |
|---|---|---|
| 1 | dress person in the suit | |
| 2 | don boots, gloves etc. as required according to the manufacturers instructions | - |
| 3 | person to enter test chamber, connect tubing to the sample point - no test agent | 3 |
| 4 | establish background reading at sample point with person standing still - no test agent | 3 |
| 5 | start test agent and allow to stabilize | 3 |
| 6 | record leakage and pressure at sample point with the person standing still .. | 3 |
| 7 | start treadmill | – |
| 8 | walk | 3 |
| 9 | record leakage and pressure at sample point with the person walking at about 5 km/h | - |
| 10 | stop treadmill | – |
| 11 | record leakage and pressure at sample point, person moving arms up and down above head height and looking upward, e.g. lifting object (half brick) from desk to shelf level | 3 |
| 12 | record leakage and pressure at sample point, person doing continuous squats | 3 |
| 13 | stop test agent and allow to desperse with person in chamber | 3 |
| 14 | disconnect sample tubes and remove person from test chamber and undress subject | - |

NOTE: The total trial may vary, all times are approximate and are to stable conditions. When doing squats, a slow deliberate action is required, say continuously during about 3 s .
Analyse results over final 2 min of each exercise period to avoid carry over of result from one exercise to the other.

Record challenge chemical continuously using a separate detector (if possible). Record the pressure inside the suit over the whole time.

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II:

| EU-Directive 89/686/EEC, Annex II | clauses of this standard |
|---|---|
| 1.1 Design principles | 4.1, 4.2, 4.3, 5.5.1 to 5.6 |
| 1.2 Innocuousness of PPE | 4.1, 4.5, 4.14, 5.2 |
| 1.3 Comfort and efficiency | 4.1, 4.3, 5.2, 5.4, annex A |
| 1.4 Information supplied by the manufacturer | clause 7 |
| 2.2 PPE 'enclosing' the parts of the body to be protected | 4.1.4, 4.5, 4.8, 5.2 |
| 2.3. PPE for the face, eyes and respiratory tracts | 4.5, 5.2 |
| 2.1 2 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety | clause 6 |
| 3.9.2.1 Protection against external radioactive contamination | clause 4, 5, 6, 7 |

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

# ATTACHMENT 3

## Protection Factor Determined During Fit Test Exercises for V4 F1

(Test Results carried out on the full encapsulated suit MURUROA V4F1 ref. 8481X1T for the EC Type Examination Certificate N°0073/197/162/12/97/0028)

Test Results carried out on the full encapsulated suit
MURUROA V4F1 ref. 8481X1T
For the EC Type Examination Certificate
N°0073/197/162/12/97/0028

You will find below the detailed results taken in account for being able to statue on the conformity of this equipment in accordance with the Essential Requirements of the European Standard pr EN 1073-1 . Other results those are non pointed out in this report are already written in the EC TYPE Examination certificate (dated December 10th 1997)

**1 – Air Flow entering the suit when connected to a 6 bar feeding pressure (paragraph 2.3.2. of the EC Type Examination Certificate)**

| Suit number | Minimum air flow(l/mn) | Maximum air flow (l/mn) |
|---|---|---|
| 1 | 508 | 1050 |
| 2 | 516 | 1070 |
| 3 | 508 | 1050 |

**2 – Carbon dioxide content of the inhalation air when measured at the minimum air flow of 450 l/mn (paragraph 2.3.12. of the EC Examination Type)**

| Suit number | Test N°1 CO2 contents(%) | Test N°2 CO2 contents(%) |
|---|---|---|
| 1 | 0,86 | 0,93 |
| 2 | 0,68 | 0,68 |
| 3 | 0,75 | 0,82 |

**3 - Noise level associated with the air supply to the suit when tested at the maximum air flow rate at 6 bar (paragraph 2.3.13 of the EC Examination Type)**

| Suit number | Maximum air flow(l/mn) | Noise level (dB) |
|---|---|---|
| 1 | 1050 | 77,2 |
| 2 | 1070 | 75,1 |
| 3 | 1050 | 77,6 |

**4 – Inward leakage average- Fit Factor measured at the minimal air flow of 450l/mn (paragraph 2.3.3. of the CE Examination Type)**

| Suit n° / Exercise | 1 | 2 | 3 |
|---|---|---|---|
| Standing still | > 120 000 | > 120 000 | > 120 000 |
| Walking ( 5 km/h) | 76 700 | 90 900 | 66 000 |
| Moving arms up and down above head | 113 800 | > 120 000 | 113 800 |
| Continuous squats | 30 000 | 41 700 | 50 000 |
| Bending forward | 110 000 | 103 400 | 91 700 |
| Person twisting at waist | > 120 000 | > 120 000 | > 120 000 |
| Person crawling | 55 000 | > 120 000 | 31 400 |

**5 - Pressure in the suit when measured at the maximum air flow when suit connected under 6 bar feeding pressure (paragraph 2.3.11.of the EC Examination Type)**

| Suit n° | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| Exercise | P min(Pa) | P Max. | P min(Pa) | P Max. | P min(Pa) | P Max. |
| Standing still | 275 | 280 | 295 | 305 | 275 | 280 |
| Walking ( 5 km/h) | 200 | 800 | 300 | 900 | 600 | 900 |
| Moving arms up and down above head | 150 | 400 | 160 | 420 | 250 | 800 |
| Continuous squats | 30 | 900 | 30 | 1050 | 70 | 1700 |
| Bending forward | 80 | 1550 | 60 | 1900 | 100 | 1900 |
| Person twisting at waist | 140 | 500 | 160 | 420 | 160 | 650 |
| Person crawling | 160 | 900 | 150 | 850 | 250 | 1050 |

**6 Air supply system (paragraph 4- 6 of the pr EN 1073-1)**

In accordance with the paragraph 4.6; the connexion between the compressed air supply system and the suit has been tested for a steady pull of 250 N. The three suits have been tested successfully. However, it appears a deformation of the fabric, near the regulation air flow device. A reinforced area could certainly avoid this deformation.

# ATTACHMENT 4

## Certificate No. 0073/197/162/12/97/0028 for Mururoa V4 F1 issued by the Institute of Nuclear Protection and Security

# INSTITUTE FOR NUCLEAR PROTECTION AND SECURITY

## Technical Center for Nuclear Equipment Certification

In accordance with the directive 89/686/EEC dated December 21th 1989 comparing the laws of the States Members Legislations relative to the Personal Protective Equipments, and the decrees n° 92-765, 766 and 768 dated July 29th 1992 transposing the directive into French Laws.

The organisation herebelow mentioned (IPSN / CTHEN) whose references are as follows:

- Address : B.P. n° 6 – 92265 Fontenay-aux-Roses Cedex (France).
- Empowered by Order of the Ministries of Employement and Agriculture dated December 24th 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23 th 1994).

Assigns the :

**EC TYPE EXAMINATION CERTIFICATE**
**N° 0073 / 197 / 162 / 12 / 97 / 0028**

To the following Personal Protective Equipment model:

- Designation: Ventilated Protective Suit against Radioactive Contamination pressurised for a single use only.
- Commercial reference : ***MURUROA V4 F1 – ref. 848 1X1T.***
- Manufacturer : DELTA PROTECTION / REDI – 69 210 Saint-Germain-Sur-L'Abresle.
- Certificate applicant : DELTA PROTECTION – Z.A. De Berret-30200 Bagnols-Sur-Ceze.
- Essential Requirements Reference : EN 143, pr EN 1073-1 (July 1997), pr EN 943-1 (October 1997), EN 270, EN 1146 (April 1997).

Date : December 10th 1997
J. CORBIERE/ Chief of CTHEN

Nota : According to article R 223-62 of the "Working Law", the empowered organisation should be informed of any modification made to the material subject of this EEC type examination certificate, as well as of any modification made to the contents of this technical file on which the delivered type certificate was based on (address, manufacturer name, quality insurance certificate extract, ...)

This certificate contains 12 pages n° 1/12 to 12/12

## 1. DESCRIPTION

It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

**MURUROA V4 F1 – ref. DELTA: 8481X1T**

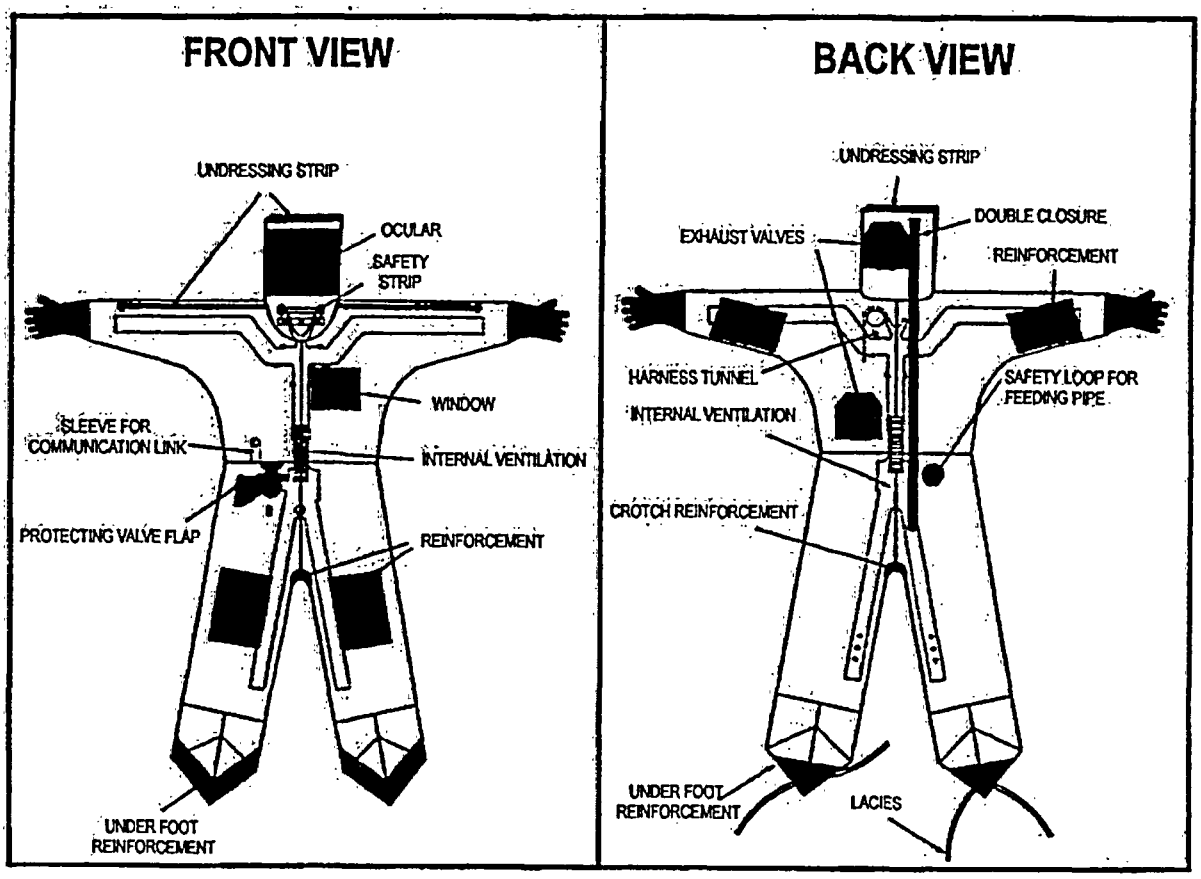
The T values are defined according to the size of the suit.

The X values are defined according to the pipe butt (Staubli or CEJN) allowing to connect the suit to the breathable compressed air supply system.

The attached list – annex 2 – gives all the references defined by this ECEC.

The suit includes:

- A air tight suit with an incorporated hood
- A suit fastening system located on the back of the suit.
- A breathable air flow supply system.
- A air exhaust device.
- A safety strip for emergency opening located on the hood.



## 1.1. MAIN MATERIALS

- **Skin of the suit :**

  PVC 9013 – Formule 1010, 20/100 mm thickness.

- **Hood:**

  PVC Cristal – 30/100 mm thickness.

- **Visor:**

  PVC (astraglass) 50/100 mm thickness.

- **Gloves:**

  PVC Sempersoft type – Size 9-91/2 for all the sizes of the suits.

- **Boots :**

  PVC 9013 – formulation 1010 – 20/100 mm thickness , reinforced PMI.

## 1.2. COMPONENTS

- **Internal Ventilation System :**

  It includes a total ventilation V4 fitted with a valve with butt.

- **Exhaust:**

  It includes two exhaust valves located on the head and on the back of the suit.

- **Fastening device:**

  It includes a double zip fastener situated vetically on the back of the suit.

- **Other components:**

  The suit includes:

- A safety strip for an emergency opening located on the hood.
- A acoustic link tunnel.
- A loop for breathable air supply pipe.
- Several internal strengthening pieces for elbows, knees and lmegs.
- A transparent window to visualise the dosimeter.

## 2. CONFORMITY TO REQUIREMENTS

### 2.1. REQUIREMENTS FOR THE MATERIALS (except accessories: Gloves, slippers...) (See paragraph 4.2. of the Norm EN 1073-1)

#### 2.1.1. Abrasion Resistance

Test according to the Norm EN 530 – method 2 (abrasive paper 00). The classification is carried out according to the following diagram:

| Class | Number of cycles |
|---|---|
| 6 | > 2 000 cycles |
| 5 | > 1500 cycles |
| 4 | > 1 000 cycles |
| 3 | > 500 cycles |
| 2 | > 100 cycles |
| 1 | > 10 cycles |

Results: Class 6 for PVC 9013 – formule 1010 – 20/100 mm thickness.
Class 6 for Cristal PVC 30/100 mm thickness.

#### .1.2. Flexcracking Resistance

Test according to the Norm ISO 7854 – method B. The clasification is carried out according to the following diagram :

| Class | Number of cycles |
|---|---|
| 6 | > 100 000 cycles |
| 5 | > 40 000 cycles |
| 4 | > 15 000 cycles |
| 3 | > 5 000 cycles |
| 2 | > 2 500 cycles |
| 1 | > 1 000 cycles |

This test is not applicable to suits for one single use only.

### 2.1.3. Puncture Resistance

Test according to the Norm EN 863. The classification is carried out according to the following diagram :

| Class | Puncture resistance |
|---|---|
| 3 | > 100 N |
| 2 | > 50 N |
| 1 | > 10 N |

Results: Class 2 for PVC Cristal – 30/100 mm thickness.
Class 1 for PVC 9013 – Formule 1010 -20/100 mm thickness.

### 2.1.4. Resistance in blocking

Test according to the Norm EN 25978. The classification is carried out according to the following diagram:

| Class | Comments |
|---|---|
| 2 | non stick |
| 1 | sticky |

This test is not applicable to non-coated materials.

### 2.1.5. Tear Resistance

Test according to the Norm EN 29073-4. The classification is according to the following diagram:

| Class | Applied strength |
|---|---|
| 6 | > 150 N |
| 5 | > 80 N |
| 4 | > 40 N |
| 3 | > 20 N |
| 2 | > 10 N |
| 1 | > 2 N |

**Results :.** Class 3 for PVC 9013 – Formule 1010 – 20/100 mm thickness.
Class 4 for Cristal PVC – 30/100 mm thickness.

### 2.1.6. Flammability of materials, visors, and ancillary parts

Tests are carried out according to the Norms EN 1146 – single burner test (paragraph 7.5.3).
**Results:** Test requirements entirely fulfilled.

## 2.2. REQUIREMENTS FOR THE ACCESSORIES

### 2.2.1. Gloves

The gloves set on the MURUROA V4 F1 ref. 8481X1T comply with the specific requirements for this type of Individual Protection Equipment, mainly to the Norm EN 421 "Protective Gloves against ionizer radiation and radioactive contamination".

They have Special EC Examination Certificates (ECEC) based on contracted tests.

### 2.2.2. Boots

The boots are part and parcel of the suit and are made of the same constituted material.

Consequently they comply with the requirements.

## 2.3. REQUIREMENTS FOR THE PROTECTIVE SUIT

### 2.3.1. Suit Design: Practical Performance Test

The Practical Performance Test is carried out according to the Norm 1073-1 (paragraph 5.2.). The conditioning is according to the manufacturer directions for use.

| Parameters | Valuations |
|---|---|
| a) Hood comfort | Aimless |
| b) Security of fastenings & couplings | Good |
| c) Accessibility of adjusting devices | Good |
| d) Clarity of vision through visor | Good |
| e) Suit comfort | Good |
| f) Speaking transmission facility | Aimless |
| g) Other parameters | No particular notice |

### 2.3.3. Air flow supply system (project Norm pr EN 1073-1 – paragraph 4.8.)

The manufacturer estimated air flow rates, for a relative air flow supply pressure of 6 bar, with a tolerance of +/- 10%, are:

- Minimal flow rate : 30,0 $m^3.h^{-1}$ (500 $l.min^{-1}$)
- Maximum flow rate : 58,4 $m^3 h^{-1}$ (973 $l.min^{-1}$)

**Notice:** In order to take into account the manufacturer indicated tolerances, this ECEC tests have been carried out under the following conditions:

Dmin = 27,0 $m^3.h^{-1}$ (450 $l.min^{-1}$)
Dmax = 64,2 $m^3.h^{-1}$ (1070 $l.min^{-1}$)

The test concerning the air flow rates of the suit has been realised according to the Norm EN 1073-1 (paragraph 5.3); For an air supply pressure of 6 bar, the air flow rate inside the suit must not be : :

- Below the minimum value estimated by the manufacturer (Dmin), when the valve is on the "stop" closed position.
- Superior to the maximum value esitimated by the manufacturer (Dmax), when the valve is on the "on" opened position.

**Results :** Requirements entirely fulfilled.

### 2.3.3. Inward leakage average – Fit Factor (paragraph 4.3. of the project Norm pr EN 1073-1)

The ratio of the average inward leakage (or its contrary : Fit Factor) has been measured according to the draft Norm pr EN 943-1 (annex A). According to the Sodium Chloride Method.

Measurements have been performed under the following conditions:

- Quantity of tested suits : 3
- Air flow rate: Adjusted and maintained on minimum flow rate (D min) as indicated in paragraph 2.3.2.
- Trainings sequence: According to the Norm EN 1073-1 Annex A list.
- Suit preliminary conditioning: According to the advice of the user manual

The ratio of the average inward leakage (or Fit Factor) gives the following classification :

| Ventilated pressurised Suit classification | Maximum accepted values, in %, of the ratio of the average Inward Leakage inside the hood, calculated on the whole lot of suits | | FIT FACTOR |
|---|---|---|---|
| | For One activity | For all activities | |
| 5 | 0.004 | 0.002 | 50 000 |
| 4 | 0.010 | 0.005 | 20 000 |
| 3 | 0.020 | 0.010 | 10 000 |
| 2 | 0.040 | 0.020 | 5 000 |
| 1 | 0.100 | 0.050 | 2 000 |

**Results :** The suit is classified 5.

### 2.3.4.1. Seams / Welds (paragraph 4.4.1 of the project Norm pr EN 1073-1)

A sample of each type of seam/weld is tested according to the Norm ISO 5082 (annex 2). The seam performance level is according to the following classification:

| Class | Seam resistance (N) |
|---|---|
| 5 | > 300 |
| 4 | > 125 |
| 3 | > 75 |
| 2 | > 50 |
| 1 | > 30 |

The tests have been applied to the folllowing welds:

- Assemblage hood/suit
- Assemblage hood/visor
- Assemblage hood level
- Assemblage belt level
- Assemblage of the strengthening pieces (elbow and knees)
- Assemblage at the level of the arms, back and sides

**Results :** All the welds are classified 4.

### 2.3.4.2. Joins and Assemblages (paragraph 4.4.2. – project Norm pr EN 1073-1)

This suit has no removable parts. This paragraph is aimless.

### 2.3.4.3. Visors (paragraph 4.5. – project Norm pr EN 1073-1)

The distorsion of vision is measured, during the Practical Performance Test, by reading letters on an optometrical chart placed at a distance of 5 m; The loss of vision must not exced 2 degrees.

The mechanical resistance test of the visor is according to the Norm EN 146 (paragraph 6.7.).

**Results :** Distortion of vision : Up to requirement.
Mechanical resistance : up to requirement.

### 2.3.6. Air supply system (paragraph 4.6. of the project Norm pr EN 1073-1)

The couplings and connections must comply with the requirements of the paragraphs 6.7.1., 6.7.2., and 6.11.7. of the Norm EN 270. The connection between the compressed air supply system and the suit must resist to a 250 N pull.

**Result:** requirement entirely fulfilled.

### 2.3.7. Breathing Hose (paragraph 4.7. of the project Norm pr EN 1073-1)

Tests are performed according to the Norm 270 (paragraph 7.2. and 7.6). The pipes must not block the movements nor cause a rupture of the air supply during the Practical Performance Test.

**Result:** No constraint.

### 2.3.8. Air flow rate warning device (paragraph 4.9. of the project Norm pr EN 1073-1)

If a warning is fitted, it must comply to the Norm EN 270 (paragraph 6.13.3). The test must be carried out according to the Norm EN 270 (paragraph 7.12). The sound level must be between 85 dB(A) and 90 dB(A).

**Result:** Aimless (there is no warning device).

### 2.3.9. Air supply valve (paragraph 4.10 of the project Norm pr EN 1073-1)

For the air supply pressure specified by the manufacturer, the air supply valve must be able to adjust the air flow between the minimum and maximum values as indicated in the technical manual. It must be impossible to close the valve in order to reduce the air flow supply below the minimum flow rate as specified by the manufacturer.

**Result:** Requirements entirely fulfilled.

**Notice:** The MURUROA does not include low air flow indicator.

### 2.3.10. Exhaust devices (paragraph 4.11. of the project Norm pr EN 1073-1)

The exhaust devices must work correctly after the testing of the pressure in the suit, during the Practical Performance Test and during the determination of the Fit Factor. Test in accordance with the Norm 1073-1 (paragraph 5.6.).

**Results :** Good valves working.
Pull resistance superior to the fixed limit.

### 2.3.11. Pressure in the suit (Paragraph 4.12. of the project Norm pr EN 1073-1)

During the activity sequence as specified, the overpressure shall not exceed 1000 Pa mean and 2000 Pa peak. A positive pressure shall be maintained.
Test is performed with maximum air flow rate D max, as stipulated in paragraph 2.3.2. on three different suits.

**Result :** Requirements entirely fulfilled.

### 2.3.12. Carbon dioxide content of the inhalation air (paragraph 4.13.-project Norm pr EN 1073-1)

The CO2 content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1 % (by volume), tested according to the Norm 270 (paragraph 7.15) with the minimum air flow rate D min indicated in paragraph 2.3.2, on three diffeent suits.

**Result:** Requirement entirely fulfilled.

### 2.3.13. Noise associated with the air supply to the suit (paragraph 4.14 - project Norm pr EN 1073-1)

Test according to the Norm 270 (paragraph 7.16). The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum air flow rate as indicated by the manufacturer.Tested at the maximum air flow rate D max as stipulated in paragraph 2.3.2, on three different suits.

**Result:** Requirement entirely fulfilled.

## 3. CHECKINGS

### 3.1. MARKING (paragraph 6 of the Norm project pr EN 1073-1)

The marking complies with the requirements of the Norms EN 340 and EN 1073-1. According to the Decree dated February 7$^{TH}$ 1997 "relative to EEC marking of the working equipment and of the Personal Protective Equipment", it includes the distinctive number of the entitled organisation for the procedure of controls of the manufactured PPE (article 11 of the EEC Directive 89/686/EEC).

The symbol "i" is included in the pictogram, in order to show that the manufacturer instructions should be read by the user..

### 3.2. MANUFACTURER INFORMATION (Paragraph 7 of the project Norm pr 1073-1)

Information comply with the specifications of the project of Norm pr 1073-1. They include the Directions for use, the conditions of use, the specific limits and restraints.
Thes documents will be corrected in order to take into account the tests results as mentionned in this ECEC.

## 3.3. MAINTENANCE MARKING

This is aimless, the suit being for one single use only.

## 4. CONCLUSIONS

Upon presentation of the tests results, the Ventilated – pressurised for a single use only, **MURUROA V4 F1 – ref. 8481X1T** is certified to ensure a protection against radioactive contamination **according the following specified limits :**

- **Minimum air flow rate:** **27,0 $m^3.h^{-1}$.**
- **Maximum air flow rate:** **64,2 $m^3.h^{-1}$.**

The **MURUROA V4 F1** is delivered without low air flow rate indicator.

Before using it, the user will have at his disposal the necessary devices to check that the minimum air flow rate, as specified by the manufacturer is reached or over reached before and during the use of the suit.

# ANNEX 1

**Description and references of the equipment certified in the EC Type Examination Certificate**

The different models of equipment, whose generic appellation is MURUROA V4 F1 ref. 8481X1T, and which are the subject of this EEC type examination certificate (ECEC), are only different on the following points:

- The type of pipe butt connecting the equipment to the breathable compressed air supply system.
- The size.

**X indicates the type of pipe butt according to the following values:**

| References | Type of butt for connection to the compressed air supply system | References of MURUROA V4 F1 associated |
|---|---|---|
| X=2 | Staubli RBE 06 6150 | 848121 T |
| X=3 | Staubli RBE 06 "détrompeur" | 848131 T |
| X=4 | CEJN 342 | 848141 T |
| X=8 | Staubli RBE 06 QR | 848181 T |

**T indicates the size of the suit according to the following values:**

| REFERENCE | Height ( cm ) | Waist measurement (cm) |
|---|---|---|
| T=0 | 152-164 | 56-64 |
| T=1 | 164-170 | 64-68 |
| T=2 | 170-176 | 68-72 |
| T=3 | 176-182 | 72-76 |
| T=4 | 182-188 | 76-80 |
| T=5 | 188-200 | 80-88 |

# ATTACHMENT 5

# Instructions for Donning and Removal of the MURUROA V4 Fully Enclosed Suit

# INSTRUCTIONS FOR DONNING AND REMOVAL THE MURUROA V4 FULLY ENCLOSED SUIT

## FOREWORD

The Mururoa suit is a fully enclosed supplied-air suit; designed for protecting the wearer against radioactive contamination brought about by contact with liquid or solid substances or by atmospheric pollutants such as solid particles, mist gases or vapors.
Made of non-flammable PVC sheet its mechanical and chemical resistance is good enough for working in most of the nuclear environments, acids, bases or low concentration solvents.
Caution should always be used around sharp edges and tools to avoid tearing of the Mururoa.
Contact with open flames or grinding spark ray for instance must be avoided to prevent perforation by melting of the PVC skin.
At any time: avoid direct contact with objects less than 5°C (41°F) or more than 60°C (140°F) temperature. It is the responsibility of the supervisor to qualify, by preliminary test, the ability of the suit to protect the wearer against the harmful atmosphere in each specific environment

## CAUTIONS

1) Care must always be taken due to the asphyxiation hazard.
2) The buddy system must be in effect with the use of this suit fed with a sufficient breathable air source with either both persons in it or the second person nearby in view with a particulate respirator ready.
3) Suit removal under ordinary circumstances requires an assistant.
4) Thorough knowledge of the safety features of the Mururoa are essential for safety!
   a) a safety strip for breathing can be pulled open should air supply be restricted.
   b) a safety strip for suit egress in an emergency is available by using pull tab on each elbow.
   c) do not over tighten any tape applied to the suit as it will prevent rapid suit removal.

5) An air supply of 1 to 3 minutes exists inside the suit should the air supply fail.

During that time, due to the magnetic exhaust valves, the garment will remain overpressurised, avoiding penetration of harmful atmospheres as long as portions of the remaining air have not been forced out of the suit such as if the wearer bends over and forces air out the discharge valves.

## DONNING

1) Review the safety features of the Mururoa with the accompanying assistant and compare with the job scope.
2) The package containing the Mururoa must have been kept 2 hours or more at a temperature around 20'C before being opened and the devices manipulated.
3) Near the job site remove garment from the bag, shake open and inspect for obvious defects.
4) Inspect the emergency egress strip to ensure that the strip can be removed easily if desired.
5) Remove the cardboard and the clear plastic faceplate protector. Remove the paper sheet placed in the head position. Discard these.
6) In the donning and removal area, verify that the local breathable air supply is working properly.
7) Connect the garment to the local air supply with a flexible hose. Take care that the hose goes through the throttle valve by using the loop at the back right side of the suit.
8) Don the suit from the back with the help of the assistant. Connect the MURUPHONE phonic system if used and check.
9) Bind the shoe joints with the shoe strips and apply tape, if necessary, to the suit gloves.
10) Zip up the mechanical zip.
11) Zip up the external plastic gas sealing zipper when the suit is inflated.
Apply an adhesive tape of sufficient width on the second zip-fastener to be shure no leak occurs.
12) Check the air supply valve and adjust to the desired flow for comfort.
13) Perform several crouching exercises to ensure the exhaust valves work; the air source is sufficient to recharge the suit to its full volume quickly and to check for leaks.
14) Proceed to the job site and begin to work. You can disconnect the hose from the air line, and travel from the donning area to the working area to reconnect your suit at the step off pad; after having insured the air source in the working area is well fed and if the time, disconnected is not more than a few dozen of seconds.
15) Comfort in breathing and in temperature can be maintained by adjusting the air inlet regulating valve during work.

## CAUTION

Should the Mururoa feel hot, deflate, or if fog appears on the faceplate, leave immediately and quietly the working area and contact your assistant for suit removal.

*Remember:*
1) The air supply of 1 to 3 minutes exists inside the suit after breaking of air supply feeding.
2) The suit emergency strips are there for your use if needed.

## SUIT REMOVAL (with assistance)

When he has to leave the working area, the wearer comes back to the dressing area where an assistant will remove the garment.

1) Remove the clothing while still connected with the air source, remove any restrictive tape (on gloves joint for instance).

2) Pull slowly on the tab of the quick release strip from forearm, overhead to forearm.

3) Carefully remove by rolling up the two half parts of the suit (front and back, without touching any exterior contaminated surfaces)

4) Continue shedding the suit down.

5) Disconnect the air feeding to the suit.

6) Step out of the suit.

7) Discard suit into appropriate container.

# EMERGENCY FEATURES

## EMERGENCY EGRESS

1) Grasp emergency pull-off strip on either elbow with hand.
2) Pull strip firmly upward until the suit separates over the head and to the other elbow.
3) Step out of suit when appropriate.
4) Move to a safe area.

## EMERGENCY BREATHING

1) Pull month strip off with either hand
2) Separate plastic of mouth and breath
3) Move to a safe area and get assistance

# ATTACHMENT 6

## Certificate No. 0073/197/162/01/96/0001 Issued for Mururoa V4 MTH2 by the Institute for Nuclear Protection and Security

# INSTITUTE FOR NUCLEAR PROTECTION AND SECURITY

## Technical Center for Nuclear Equipment Certification

In accordance with the directive 89/686/EEC dated December 21 th 1989 comparing the laws of the States Members Legislations relative to the Personal Protective Equipments, and the decrees n° 92-765, 766 and 768 dated July 29th 1992 transposing the directive into French Laws.

The organisation here below mentioned (IPSN / CTHEN) whose references are as follows:

- Address : B.P. n° 6 – 92265 Fontenay-aux-Roses Cedex (France).
- Empowered by Order of the Ministries of Employment and Agriculture dated December 24th 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23 th 1994).

Assigns the :

**EC TYPE EXAMINATION CERTIFICATE**
**N° 0073 / 197 / 162 / 01 / 96 / 0001**

To the following Personal Protective Equipment model:

- Designation: Ventilated Protective Suit against Radioactive Contamination pressurised for a single use only.
- Commercial reference : ***MTH 2 – ref. 841 442 T.***
- Manufacturer : DELTA PROTECTION / REDI – 69 210 Saint-Germain-Sur-L'Abresle.
- Certificate applicant : DELTA PROTECTION – Z.A. De Berret-30200 Bagnols-Sur-Ceze.
- Essential Requirements Reference : EN 143, pr EN 1073 (nov. 1995), pr EN 943 (august 1995), EN 270, EN 146.

Date : January 10th 1996
G.BRUHL / Chief of CTHEN

Nota : According to article R 223-62 of the "Working Law", the empowered organisation should be informed of any modification made to the material subject of this EEC type examination certificate, as well as of any modification made to the contents of this technical file on which the delivered type certificate was based on (address, manufacturer name, quality insurance certificate extract, ...)

This certificate contains 12 pages n° 1/9 to 9/9

## 1. DESCRIPTION

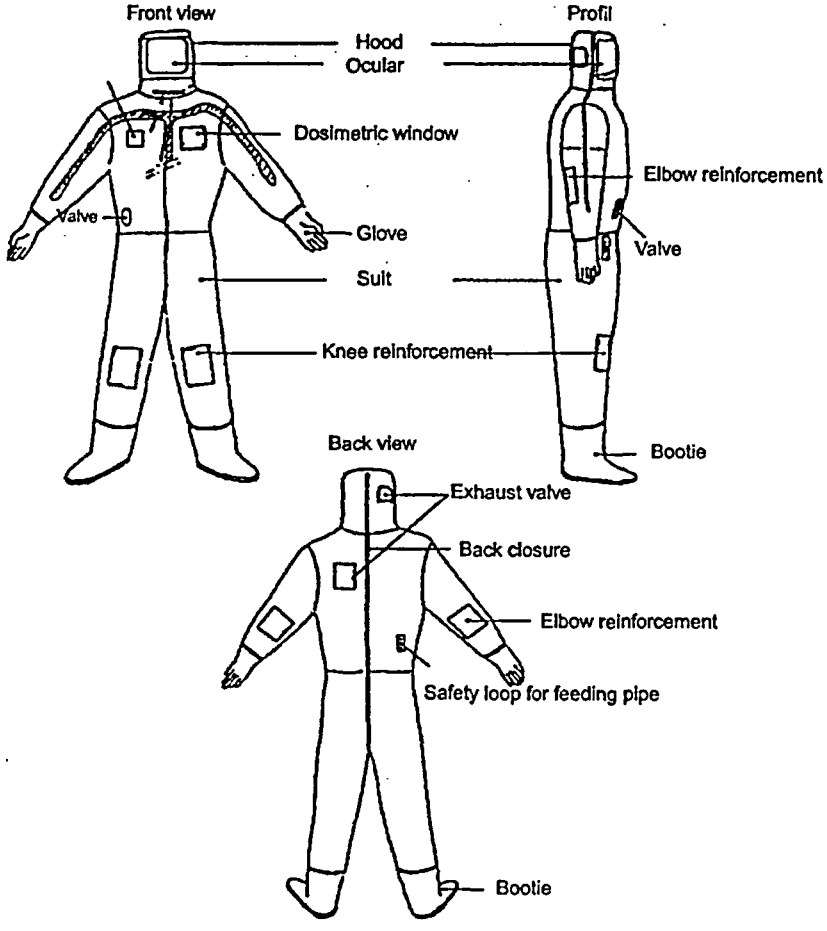
It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

**MTH2 – ref. DELTA: 841 442 T**

The T values are defined according to the size of the suit.

The suit includes:

- A air tight suit with an incorporated hood
- A suit fastening system located on the back of the suit.
- A breathable air flow supply system.
- A air exhaust device.
- A safety strip for emergency opening located on the hood.



## 1.1. MAIN MATERIALS

- **Skin of the suit :**

  White polyethylene: Ethyfuge 2000 Thickness: 24/100 mm

- **Hood:**

  PE Cristal – 30/100 mm thickness.

- **Visor:**

  PVC (astraglass) 50/100 mm thickness.

- **Gloves:**

  PVC Sempersoft type – Size 9-91/2, and Semperstar type – size 10-10 ½..

- **Boots :**

  Polyethylene – 24/100 mm thickness , reinforced with PE cristal.

## 1.2. COMPONENTS

- **Internal Ventilation System :**

  It includes a total ventilation V4 fitted with a valve with CEJN (réf:342) butt.

- **Exhaust:**

  It includes two exhaust valves located on the head and on the back of the suit.

- **Fastening device:**

  It includes a double zip fastener located vertically on the back of the suit.

- **Other components:**

  The suit includes:

- A safety strip for an emergency opening located on the hood.
- A acoustic link tunnel.
- A loop for breathable air supply pipe.
- Several internal strengthening pieces for elbows, knees and legs.
- A transparent window to visualise the dosimeter.

# 2. CONFORMITY TO REQUIREMENTS

## 2.1. REQUIREMENTS FOR THE MATERIALS (except accessories: Gloves, slippers...) (See paragraph 5.1. of the prEN 1073)

### 2.1.1. Abrasion Resistance

Test according to the Norm EN 530 – method 2 (abrasive paper 00). The classification is carried out according to the following diagram:

| Class | Number of cycles |
|---|---|
| 6 | > 2 000 cycles |
| 5 | > 1500 cycles |
| 4 | > 1 000 cycles |
| 3 | > 500 cycles |
| 2 | > 100 cycles |
| 1 | > 10 cycles |

Results: Class 6 for Ethyfuge 2000 – 24/100 mm thickness.
Class 6 for PVC.

### .1.2. Flex cracking Resistance

Test according to the Norm ISO 7854 – method B. The classification is carried out according to the following diagram :

| Class | Number of cycles |
|---|---|
| 6 | > 100 000 cycles |
| 5 | > 40 000 cycles |
| 4 | > 15 000 cycles |
| 3 | > 5 000 cycles |
| 2 | > 2 500 cycles |
| 1 | > 1 000 cycles |

This test is not applicable to suits for one single use only.

### 2.1.3. Puncture Resistance

Test according to the Norm EN 863. The classification is carried out according to the following diagram :

| Class | Puncture resistance |
|---|---|
| 3 | > 100 N |
| 2 | > 50 N |
| 1 | > 10 N |

Results: Class 1 for Ethyfuge 2000 – 24/100 mm thickness.
Class 2 for PE cristal.

### 2.1.4. Resistance in blocking

Test according to the Norm ISO 5978. The classification is carried out according to the following diagram:

| Class | Comments |
|---|---|
| 2 | non stick |
| 1 | sticky |

This test is not applicable to non-coated materials.

### 2.1.5. Tear Resistance

Test according to the Norm ISO 9073-4. The classification is according to the following diagram:

| Class | Applied strength |
|---|---|
| 6 | > 150 N |
| 5 | > 80 N |
| 4 | > 40 N |
| 3 | > 20 N |
| 2 | > 10 N |
| 1 | > 2 N |

**Results :.** Class 4 for Ethyfuge 2000 – 24/100 mm thickness.

Class 3 for PE Cristal.

### 2.1.6. Flammability of materials, visors, and ancillary parts

Tests are carried out according to the Norms EN 1146 – single burner test (paragraph 7.5.3).

**Results:** Test requirements entirely fulfilled.

## 2.2. REQUIREMENTS FOR THE ACCESSORIES

### 2.2.1. Gloves

The gloves set on the MTH2 ref. 841 442 T comply with the specific requirements for this type of Individual Protection Equipment, mainly to the Norm EN 421 "Protective Gloves against ionizer radiation and radioactive contamination".

They have Special EC Examination Certificates (ECEC) based on contracted tests.

### 2.2.2. Boots

The boots are part and parcel of the suit and are made of the same constituted material.

Consequently they comply with the requirements.

## 2.3. REQUIREMENTS FOR THE PROTECTIVE SUIT

### 2.3.1. Suit Design: Practical Performance Test

The Practical Performance Test is carried out according to the prEN 1073 (paragraph 6.2.). The conditioning is according to the manufacturer directions for use.

| Parameters | Valuations |
|---|---|
| a) Harness comfort | Aimless |
| b) Security of fastenings & couplings | Good |
| c) Accessibility of adjusting devices | Good |
| d) Clarity of vision through visor | Good |
| e) Suit comfort | Good |
| g) Other parameters | No particular notice |

### 2.3.2. Fit Factor (paragraph 5.2.2. of the pr EN 1073)

The protection factor is determined according to the PrEN 944 standard (paragraph 8.9) by respecting the sequences indicated in Annex A of the PrEN 1073.
The mean leakage value ( or inversely, the protection factor) enables a clothing classification according to the following table. The preconditioning according to the instructions for use recommendations.

| Ventilated pressurised Suit classification | Maximum accepted values, in %, of the ratio of the average Inward Leakage inside the hood, calculated on the whole lot of suits | | FIT FACTOR |
|---|---|---|---|
| | For One activity | For all activities | |
| 5 | 0.004 | 0.002 | 50 000 |
| 4 | 0.010 | 0.005 | 20 000 |
| 3 | 0.020 | 0.010 | 10 000 |
| 2 | 0.040 | 0.020 | 5 000 |
| 1 | 0.100 | 0.050 | 2 000 |

**Results :** The suit is classified 5.

### 2.3.3.1. Seams, Joins and Assemblages pull test resistance

### 2.3.3.1. Seams / Welds (paragraph 5.2.3.1 of the pr EN 1073)

A sample of each type of seam/weld is tested according to the Norm ISO 5082 (annex 2). The seam performance level is according to the following classification:

| Class | Seam resistance (N) |
|---|---|
| 5 | > 300 |
| 4 | > 125 |
| 3 | > 75 |
| 2 | > 50 |
| 1 | > 30 |

The tests have been applied to the following welds:

- Elbow and knee reinforcement
- Crotch assembly
- Belt assembly
- Booties assembly
-

**Results :** All the welds are classified 3.

### 2.3.3.2. Joins and Assemblages (paragraph 5.2.3.2. – prEN 1073)

This suit has no removable parts. This paragraph is aimless.

### 2.3.4 Gas tight (paragraph 5.2.4. of prEN 1073.

The test was carried out according to the EN 464 standard . The loss of pressure shall not be greater than 4 mbar in 6 minutes.

**Results :** Test not undertaken as the clothing is not considered as an gastight suit.

### 2.3.5. Visors (paragraph 5.2.5. of prEN 1073)

The distortion of vision is measured, during the Practical Performance. The mechanical resistance test of the visor is according to the Norm EN 146 (paragraph 6.6 and 6.7.).

**Results :** Distortion of vision : Up to requirement.
Mechanical resistance : up to requirement.

### 2.3.6. Air supply system (paragraph 5.2.6. of the pr EN 1073)

The couplings and connections must comply with the requirements of the paragraphs 6.7.1., 6.7.2., and 6.11.7. of the EN 270. The connection between the compressed air supply system and the suit must resist to a 250 N pull.

**Result:** requirement entirely fulfilled.

### 2.3.6. Breathing Hose (paragraph 5.2.7. of the pr EN 1073)

Tests are performed according to the EN 270 (paragraph 7.2. and 7.6). The pipes must not block the movements nor cause a rupture of the air supply during the Practical Performance Test.

**Result:** No constraint.

### 2.3.7. Air supply flow rate (paragraph 5.2.8. of the PrEN 1073)

The test is carried out according to the PrEN 1073 standard (paragraph 6.3).

**Result:**

Minimal flow rate:30 $m^3.h^{-1}$ (500 $l/min^{-1}$) for a 6 Bar supply pressure

Maximal flow rate:66 $m^3.h^{-1}$ (1100 $l/min^{-1}$) for a 5.5 Bar supply pressure

### 2.3.8. Air flow rate warning device (paragraph 5.2.9. of the pr EN 1073)

If a warning is fitted, it must comply to the EN 270 (paragraph 6.13.3). The test must be carried out according to the EN 270 (paragraph 7.12). The sound level must be higher than 85 dB(A).

**Result:** Aimless (there is no sonic warning device).

### 2.3.9. Air supply valve (paragraph 5.2.10 of the pr EN 1073)

Where present, the control valve should enable a variation of flow rate between the minimum and maximum specified values without the possibility of closure.

**Result:** Requirements entirely fulfilled.

### 2.3.11.Exhaust devices (paragraph 5.2.11. of the pr EN 1073)

The exhaust devices must work correctly after the testing of the pressure in the suit, during the Practical Performance Test and during the determination of the Fit Factor. Test in accordance with the EN 1073 (paragraph 6.6.).

**Results :** Good valves working.
Pull resistance superior to the fixed limit.

### 2.3.12. Pressure in the suit

During the activity sequence as specified, the overpressure shall not exceed 1000 Pa mean and 2000 Pa peak. A positive pressure shall be maintained.

**Result:** Requirements entirely fulfilled.

### 2.3.13. Carbon dioxide content of the inhalation air

The $CO_2$ content of the inhalation air, determined at the minimum air flow rate, shall not exceed an average of 1 % (by volume), tested according to the EN 270 (paragraph 7.15).

**Result:** Requirement entirely fulfilled.

### 2.3.14. Noise associated with the air supply to the suit (paragraph 5.2.14 - pr EN 1073)

Test according to the EN 270 (paragraph 7.16). The noise measured in the suit at the ears shall not exceed 80 dB(A) at the maximum air flow rate as indicated by the manufacturer.

**Result:** Requirement entirely fulfilled.

## 3. CHECKINGS

### 3.1. MARKING (paragraph 7 of the pr EN 1073)

The marking is satisfies the requirements of article 7 in the EN 340.

### 3.2. MANUFACTURER INFORMATION (Paragraph 8 of the pr 1073)

The manufacturers information complies with the specifications in paragraph 8 of the EN 340. They contain the instructions for use, the usage conditions and the specific limits and restraints.

### 3.3. MAINTENANCE MARKING

This is aimless, the suit being for one single use only.

## 4. CONCLUSIONS

Upon presentation of the tests results, the Ventilated suit – pressurised for a single use only, **MTH 2 – ref. 841 442 T** is certified to ensure a protection against radioactive contamination **according the following specified limits :**

- **Minimum air flow rate:** **30 $m^3.h^{-1}$ (500 $l.min^{-1}$)**
- **Maximum air flow rate:** **66 $m^3.h^{-1}$.(1100 $l.min^{-1}$)**

# ATTACHMENT 7

## Protection Factor Determined During Fit Test Exercise for V4 MTH2

(Test Results carried out on the full encapsulated suit MTH2 ref. 841442T
For the EC Type Examination Certificate No. 0073/197/162/01/96/0001)

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Test Results carried out on the full encapsulated suit
MTH2 ref. 841442T
For the EC Type Examination Certificate
N°0073/197/162/01/96/0001

You will find below the detailed results taken in account for being able to statue on the conformity of this equipment in accordance with the Essential Requirements of the European Standard pr EN 1073-1 (revision Nov 1995). Other results those are non pointed out in this report are already written in the EC TYPE Examination certificate (dated December 10th 1997)

**1 – Air Flow entering the suit when connected to a 6 bar feeding pressure (paragraph .5.2.8. of the EC Type Examination Certificate)**

| Suit number | Entrance valve position | Air flow feeding pressure Bar / *psig* | air flow (m3/h / l/mn/ *cfm*) |
|---|---|---|---|
| 1 | Fully open | 5,5 / *77* | 66/1100/ *38* |
| 1 | Closed | 6,0 / *87* | 30 / 500 / *17* |
| 2 | Fully open | 5,5 / *77* | 65 / 1080 / *37,8* |
| 2 | closed | 6,0 / *87* | 31 / 516 / *18* |

**2 – Carbon dioxide content of the inhalation air when measured at the minimum air flow (paragraph 5.2.13. of the EC Examination Type)**

| Suit number | Feeding pressure Bar / *psig* | Air flow M3/h / *cfm* | CO2 contents(%) |
|---|---|---|---|
| 1 | 6 / *87* | 30 / *17* | 0,85 |
| 2 | 6 / *87* | 31 / *18* | 0,80 |

**3 - Noise level associated with the air supply to the suit when tested at the maximum air flow rate (paragraph 5.2.14 of the EC Examination Type)**

| Suit number | Feeding pressure Bar / *psig* | Air flow M3/h; *cfm* | Noise level (dB) |
|---|---|---|---|
| 1 | 5,5 / *77* | 66 / *38* | 76,8 |
| 2 | 5,5 / *77* | 65 / *37,8* | 78,5 |

**4 – Inward leakage average- Fit Factor measured at the minimal air flow of 450l/mn (paragraph 2.3.3. of the CE Examination Type)**

| Suit n° / Exercise | 1 | 2 |
|---|---|---|
| Air flow m3/h/ l/mn / *cfm* | 30 / 500 / *17* | 31 / 516 / *18* |
| Standing still | 130 000 | 130 000 |
| Walking ( 5 km/h) | 59 500 | 50 000 |
| Moving arms up and down above head | 125 000 | 125 000 |
| Continuous squats | 65 000 | 81 250 |
| Bending forward | 100 000 | 92 850 |
| Person twisting at waist | 115 000 | 130 000 |
| Standing still | 130 000 | 130 000 |
| Average | 103 500 | 103 440 |

**5 - Pressure in the suit when measured at the maximum air flow when suit connected under 5,5 bar (77psig) feeding pressure (paragraph 4.12.of the EC Examination Type)**

| Suit n° / Exercise | 1 P ave/ P min/ Pmax daPa. | | | 2 P ave; P min, P Max. daPa | | |
|---|---|---|---|---|---|---|
| Standing still | 40 | - | - | 38 | - | - |
| Walking ( 5 km/h) | 40 | 23 | 74 | 100 | 61 | 128 |
| Moving arms up and down above head | 40 | 17 | 62 | 46 | 18 | 72 |
| Continuous squats | 42 | 4 | 86 | 56 | 3 | 110 |
| Bending forward | 52 | 3 | 104 | 74 | 0 | 162 |
| Person twisting at waist | 38 | 18 | 58 | 46 | 20 | 110 |
| Person crawling | 37 | - | - | 40 | - | - |

For Information: Both overboots are breaked at the end of the test

6 **Over pressure and fit factor when person crawling on the floof as indicated in paragraph 4.12 and 5.2.2 of the pr EN 1073-1dated 1995**

| Suit number | Crawling exercise | | | |
|---|---|---|---|---|
| | Average DP daPa | Minimum DP daPa | Maximum DP daPa | Fit Factor |
| 1 | 52 | 12 | 90 | 110 000 |
| 2 | 65 | 3 | 102 | 105 000 |

7 **Screen:( paragraph 5.2.5 )**

- **Distortion of the vision:** none
- **Mechanical resistance :** no incidence on the screen.

# ATTACHMENT 8

# Donning and Removal Instructions for Mururoa V4 MTH2

# M.T.H.2

## INSTRUCTIONS FOR USE

Preliminary remarks : This clothing is to be used under the authority of the person responsible for issuing the equipment for its dedicated use :

- the clothing offers the necessary protection for it's intended use.
- Breathable air *network, hoses with connectors compatible with that of the clothing, are actually available on site and that they are capable of supplying a sufficient quantity of air :

| | |
|---|---|
| minimum flow rate | 500 liters/min. +/- 10% at 6 Bars ; (17 cfm at 87 psig) |
| maximum flow rate | 1100 liters/min. +/- 10% at 6 Bars ; (38cfm at 87 psig) |

**DRESSING**

- The wearer, with a helper, visually inspects the condition of the garment and its components, then removes the shipping protection (cardboard on the visor and inside the garment, and removable "plastic protection" from the visor).
- He enters through the rear opening of the garment and insures that his legs are in the garment.
- Connects to the breathable air network by passing the supply line through the loop at the rear of the garment, at the same height as the supply valve.
- Connects , if used, the MURUPHONE system, or other communication device through the safety loop and communication loop and finishes dressing.
- The helper zips up the dual zipper system and applies a large strip of adhesive tape to the upper extremity of the second zipper at the top to ensure air tightness. He then, ties the over boot laces around the ankles.
- The wearer can control the air supply by turning the adjustment knob. The correct functioning of the supply flow valve and the over pressure valves can be verified by crouching down rapidly a few times.
- He then is free to enter the work zone.

**UNDRESSING**

- Undressing may be done in the following manner. While the garment is still being supplied with air , the helper pulls on the orange undressing strip, which runs from one wrist to the other over the hood. Once the undressing strip is removed, the helper can split the suit shell by pulling on the hooded area and separating the suit into two identical pieces. The helper rolls up the front and rear parts in a way that traps the contamination and avoids all contact with the wearer of the garment. (Please consult our video for detailed undressing techniques).

**IMPORTANT**

- Leave the work zone immediately if the clothing deflates during the work phase evolution .If the helmet fogs, or if the person has a feeling of excessive warmth.
- Remember that the clothing remains pressurised for a few minutes in case of an air supply failure

**STORAGE**

In the original packaging; out of the light; between + 5°C and + 45°C.( 41°F and 113°F)

**USAGE**

The air supply should be between + 15°C and + 45°C. ( 59°F and 113°F)

**EXPIRY DATE**

The clothing should be used by the third year from the date of manufacture.

**CLEANING**

Not necessary for this type of equipment which is for a single use only.

**EMERGENCY FEATURES**

- Air outside of the garment can be breathed by removing the safety strip at the front of the helmet/hood.
- The undressing strip, removed by the wearer, enables the wearer to self escape t in less than 5 seconds.

* Breathable air : see the EN 132 standard.