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*Energy to Serve Your World*

March 23, 2009

Docket Nos.: 50-321 50-348 50-424  
50-366 50-364 50-425

NL-09-0364

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D. C. 20555-0001

Edwin I. Hatch Nuclear Plant  
Joseph M. Farley Nuclear Plant  
Vogtle Electric Generating Plant  
Request for Assigned Protection Factors to Use with  
French-Designed Air-Line Respirator Equipment

Ladies and Gentlemen:

Pursuant to 10 CFR 20.1705, "Application for Use of Higher Assigned Protection Factors," Southern Nuclear Operating Company (SNC) requests Nuclear Regulatory Commission (NRC) approval to use an Assigned Protection Factor (APF) of 5000 associated with the French-designed Delta Protection Mururoa Supplied-Air V4F1 and V4 MTH2 containment suits. These suits are proposed for use as respiratory protection equipment at Edwin I. Hatch Nuclear Plant (HNP), Joseph M. Farley Nuclear Plant (FNP) and Vogtle Electric Generating Plant (VEGP). Approval is requested by June 1, 2009 to support implementation prior to the VEGP Unit 1 fall outage.

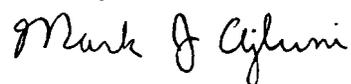
The Delta Protection Mururoa Supplied-Air V4F1 and V4 MTH2 suits have been previously approved by the NRC with an APF of 5000 for use at other plants including the Constellation plants on January 19, 2006 (ML053570243) and V.C. Summer Nuclear Station on May 6, 2008 (ML081210403). The Delta Protection suits have been widely used in western European nuclear power plants (the manufacturer indicates that approximately 60,000 Delta Protection suits are used by these plants each year). The suits received certification for use by the Institute for Nuclear Protection and Security (the European certifying agency which is comparable to NIOSH) in 1996.

Enclosure 1 provides the documentation supporting the request. As described in this enclosure, use of the Delta Protection suits would improve worker safety in areas of airborne radioactivity, contamination control, heat stress reduction, and respiratory protection.

Enclosure 2 describes the regulatory commitments SNC has identified for use of the Delta Protection suits.

If you have any questions, please advise.

Sincerely,



M. J. Ajluni  
Manager, Nuclear Licensing

MJA/TAH/daj

Enclosures: 1. Assessment of French-Designed Air-Line Respirator Equipment  
2. List of Regulatory Commitments

cc: Southern Nuclear Operating Company  
Mr. J. T. Gasser, Executive Vice President  
Mr. J. R. Johnson, Vice President – Farley  
Mr. D. R. Madison, Vice President – Hatch  
Mr. T. E. Tynan, Vice President – Vogtle  
Mr. D. H. Jones, Vice President – Engineering  
RType: CFA04.054; CHA02.004; CVC7000

U. S. Nuclear Regulatory Commission  
Mr. L. A. Reyes, Regional Administrator  
Mr. R. E. Martin, NRR Project Manager – Farley, Hatch, Vogtle  
Mr. E. L. Crowe, Senior Resident Inspector – Farley  
Mr. J. A. Hickey, Senior Resident Inspector – Hatch  
Mr. M. Cain, Senior Resident Inspector – Vogtle

**Edwin I. Hatch Nuclear Plant  
Joseph M. Farley Nuclear Plant  
Vogtle Electric Generating Plant  
Request for Use of French Designed air-Line Respirator  
Equipment and Higher Assigned Protection Factors**

**Enclosure I**

**Assessment of French-Designed Air-Line Respirator Equipment**

**Edwin I. Hatch Nuclear Plant  
Joseph M. Farley Nuclear Plant  
Vogtle Electric Generating Plant  
Request for Use of French Designed air-Line Respirator  
Equipment and Higher Assigned Protection Factors  
Assessment of French-Designed Air-Line Respirator Equipment**

**Enclosure 1**

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# Assessment of Delta Protection Supplied-Air Containment Suits

## Enclosure 1

### 1.0 Introduction

#### 1.1 Purpose

SNC has identified the Delta Protection Mururoa Supplied-Air Suits, models V4F1 and V4 MTH2, as having benefits associated with contamination control, heat stress reduction, and respiratory protection. These suits have not been approved by National Institute for Occupational Safety and Health (NIOSH) for use as a respirator to limit the intake of radioactive material in the United States. Based on a review of 10 CFR 20.1703, 10 CFR 20.1705 and 10 CFR 20 Appendix A, pursuant to 10 CFR 20.1705, SNC is required to submit a request to the Nuclear Regulatory Commission to use an assigned protection factor (APF) of 5000.

The Delta Protection Mururoa Supplied-Air V4F1 and V4 MTH2 suits have been previously approved by the NRC with an APF of 5000 for use at other plants including the Constellation plants on January 19, 2006 (ML053570243), and the V.C. Summer Nuclear Station on May 6, 2008 (ML081210403). The Delta Protection suits have been widely used in western European nuclear power plants (the manufacturer indicates that approximately 60,000 Delta Protection suits are used by these plants each year). The suits received certification for use by the Institute for Nuclear Protection and Security (the European certifying agency which is comparable to NIOSH) in 1996.

#### 1.2 Background

##### 1.2.1 Regulatory Requirements

The following regulatory requirements are relevant to this request.

10 CFR 20.1703(a), "Use of Individual Respiratory Protection Equipment," states that if a licensee assigns or permits the use of respiratory protection equipment to limit the intake of radioactive material, the licensee shall use only respiratory protection equipment that is tested and certified by NIOSH, except as otherwise noted in this part.

10 CFR 20.1703(b) states that if the licensee wishes to use equipment that has not been tested or certified by NIOSH, or for which there is no schedule for testing or certification, the licensee shall submit an application to the NRC to authorize use of the equipment except as provided in this part.

10 CFR 20.1703(f) requires the use of a standby rescue person whenever one-piece air-supplied suits are used which an unaided person would have difficulty extricating himself or herself.

10 CFR 20.1705, "Application for Use of Higher Assigned Protection Factors," requires that a licensee shall obtain authorization from the NRC before using assigned protection factors in excess of those specified in 10 CFR 20, Appendix A.

## **Assessment of Delta Protection Supplied-Air Containment Suits**

### **Enclosure 1**

10 CFR 20, Appendix A, "Assigned Protection Factors for Respirators," Item II, "Atmosphere Supplying Respirators (particulate, gases and vapors)," indicates that for a suit in a continuous flow operating mode, no APF is assigned nor is a NIOSH approval schedule currently available for the evaluation of such 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., section 20.1703).

The respiratory protection program at SNC complies with 10 CFR 20.1703. However, since no APF is provided in 10 CFR 20 Appendix A for air-supplied suits, SNC is required to obtain NRC approval for the assignment of a protection factor.

#### **1.2.2. Suit Construction**

The Delta Protection Supplied-Air Containment Suit meets International Organization for Standardization (ISO) 8194, "Radiation Protection -Clothing for Protection Against Radioactive Contamination -Design, Selection, Testing, and Use," and the European Standard EN 1073-1, "Protective Clothing Against Radiation Contamination."

The Delta Protection suits have the following desirable features (Attachments 1 and 2):

- One-piece construction, that includes integral gloves and booties
- PVC (FI) or Ethyfuge (MTH2) skin material with reinforced elbows, knees and crotch areas
- Dual zippers -metal zipper inside and plastic zipper outside
- Clear Poly Vinyl Chloride (PVC) helmet that provides distortion-free vision
- Welded sleeve to insert communication cable
- A removable strip near the mouth that could be used for emergency breathing in case of loss of supplied air
- Air intake located at the waist with a built-in regulator that can adjust, but not block, airflow
- Two exhaust valves that ensure the suit remains airtight should an event block/pinch the air supply line
- Low noise level
- Air flow to arms, legs, and face

Air hoses of any length can be used, but air shall be supplied to the Delta Protection suits at 85 psig  $\pm$  10% measured at the inlet. A regulator at the inlet is used to adjust the airflow. To ensure user safety, the regulator cannot shut off the air supply. There are two patented exhaust valves on the back of the suit -one behind the neck and one at the lower back. The exhaust valves prevent any aspiration of contaminants if supplied air is lost.

The Delta Protection suits are approved for use with 16 different fittings in Europe and can be fitted with Snap-Tite, Schrader, Foster or CEJN type fittings used at SNC.

## **Assessment of Delta Protection Supplied-Air Containment Suits**

### **Enclosure 1**

#### **1.2.3 Safety Features of the Delta Protection Supplied-Air Containment Suits**

In addition to the features described in Section 1.2.2, above, the Delta Protection Supplied-Air Containment Suits are lightweight (approximately 2 lbs), and are available with a fire-retardant treatment. The Institute for Nuclear Protection and Security (IPSN) certifies the suit has the appropriate resistance to abrasion, flex cracking, puncture, tearing, and flammability. The noise level at maximum airflow is less than 80 dba. Airflow 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 the 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. The Delta Protection suit's design does not permit its use in an Immediately Dangerous to Life and Health (IDLH) atmosphere. SNC will use this suit for protection against radioactive particulate contamination, and will not allow use in an IDLH atmosphere.

#### **1.2.4 Implementation**

SNC has air-supplied hoods (commonly known as bubble hoods) for use on jobs involving overhead-contaminated water or high potential for skin contamination. Because the bubble hoods do not cover the hands or feet, workers have to wear additional protective clothing to minimize potential skin contaminations in these areas. Because of its one piece construction and ease of removal, the Delta Protection suits offer a better alternative for protection against facial/skin contamination and airborne radioactivity than the bubble hoods currently in use. Use of the Delta Protection suits would assist in SNC's efforts to control contamination incidents and to prevent intakes during maintenance activities.

The Delta Protection suits will be integrated into the existing SNC radiological respiratory protection program using the manufacturer's recommendations described in the "Mururoa V4 Fully Enclosed Suit -General Description" (Attachment 2), the "Instructions for Donning and Removal of the Mururoa V4 Fully Enclosed Suit" (Attachment 3), and the "Mururoa V4F1 and V4-MTH2 Instructions For Use" (Attachment 4). No exceptions will be taken with the minor clarification that the suits will be inspected and removed from their protective packaging outside of the plant's radiologically controlled area in a way that maintains the integrity of the suit, but does not lead to the unnecessary generation of solid radioactive waste. Workers will be trained on the Delta Protection suit features, donning, use and removal, use of mouth strip and use of tear off strips for routine and emergency egress. Radiation Protection personnel will be trained on selection, approval, issue, equipment set-up, operation, and maintenance instructions for the Delta Protection suit.

Any defects discovered will be entered into the SNC Corrective Action Program and reported to the manufacturer, as necessary. Industry notifications will be made through the Operating Experience Program.

# Assessment of Delta Protection Supplied-Air Containment Suits

## Enclosure 1

### 2.0 Technical Justification

#### 2.1 Evaluation

SNC has reviewed the following documents (Attachments) obtained from Delta Protection:

1. Delta Protection/Bacou-Dalloz Anti-Contamination Suit Brochure (Attachment 1),
2. Delta Protection Mururoa V4 Fully Enclosed Suit -General Description (Attachment 2),
3. Instructions for Donning and Removal of the Mururoa V4 Fully Enclosed Suit (Attachment 3),
4. Mururoa V4F1 and MTH2-V4 Instructions for Use (Attachment 4),
5. European Standard EN 1073-1, January 1998, "Protective Clothing Against Radioactive Contamination" (Attachment 5),
6. Institute for Nuclear Protection and Security EC Type Examination Certificate No. 0073/ 197 /162 /01 / 96/ 0001 (Delta Protection MTH2 suits) (Attachment 6),
7. 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 (Attachment 7),
8. Institute for Nuclear Protection and Security EC Type Examination Certificate No. 0073/ 197/ 162/ 12/ 97/ 0028 (Mururoa V4F1) (Attachment 8), and
9. Test Results Carried Out on the Full Encapsulated Suit Mururoa V4F1 Ref: 8481X1T for the EC Type Examination Certificate No. 0073/ 197/ 162/ 12/ 97/ 0028 (Attachment 9).

Based on a review of this documentation, the suits represent a better design than the currently approved bubble hood and provide better contamination control, heat stress reduction, and respiratory protection.

A key element of this review was the application of the European Standard and the Certificate issued by the Institute for Nuclear Protection and Security for the Delta Protection suits. The European Standard (Attachment 5) requires that the suit satisfy requirements associated with resistance to abrasion, flex cracking, puncture, blocking, tear and flammability, strength of seams, joints and assemblies, damage resistance of exhaust valves, designed flow rates for pressure range of supplied air, noise level, and quality of the visor. According to the testing standard, two workers should perform standard tests to determine the practicality of the suit. Standard tests include walking at a rate of 5 km/hr for 5 minutes and loading a bucket of chips from the base of a hopper and emptying it into the opening on top of the hopper repeated 15-20 times in 10 minutes. Additionally, a protection factor for the suit is determined. The testing standard requires two individuals to test two separate suits in a test chamber filled with sodium chloride.

## **Assessment of Delta Protection Supplied-Air Containment Suits**

### **Enclosure 1**

The testing methodology includes the performance of a variety of exercises during the test. Certificate No. 0073 / 197 / 162 / 12 / 97 / 0028 (Attachments 8 and 9) states that the Delta Protection F1 suit passed in all categories tested and provided a fit factor of 50,000. Certificate No. 0073 / 197 / 162 / 01 / 96 / 0001 (Attachments 6 and 7) states that the Delta Protection MTH2 suit passed in all categories tested and provided a fit factor of 50,000. SNC is requesting an APF of 5000 (10% of the documented fit factor). The Delta Protection suit's safety features, namely the emergency egress strip, which allows the suit to be quickly removed and the tear-off mouth strip for use on loss of air make the assignment of standby rescue personnel unnecessary.

### **3.0 References**

1. 10 CFR 20.1703, "Use of Individual Respiratory Protection Equipment"
2. 10 CFR 20.1705, "Application for Use of Higher Assigned Protection Factors"
3. 10 CFR 20, Appendix A, "Assigned Protection Factors for Respirators"
4. Letter dated May 6, 2008, NRC to South Carolina Electric and Gas Company, "Virgil C. Summer Nuclear Station, Unit No. 1, Approval for Use of Assigned Protection Factor with French-Designed Air Supplied Respirator Equipment (TAC Nos. MD8126)," ADAMS Accession No. ML081210403
5. Letter dated January 19, 2006, NRC to Constellation Energy Generation Group; Calvert Cliffs Nuclear Plant, Unit Nos. 1 and 2, R.E. Ginna Nuclear Power Plant, and Nine Mile Point Nuclear Power Station, Unit Nos. 1 and 2 Authorization for Use of Delta Protection Mururoa Single Use Supplied Air Suits, Model V4 MTH2, with an Assigned Protection Factor of 5000 (TAC Nos. MC8680, MC8681, MC8682, MC8683, and MC8684)," ADAMS Accession No. ML053570243

### **4.0 Attachments**

1. Delta Protection/Bacou-Dalloz Anti-Contamination Suit Brochure
2. Delta Protection Mururoa V4 Fully Enclosed Suit -General Description
3. Instructions for Donning and Removal of the Mururoa V4 Fully Enclosed Suit
4. Mururoa V4F1 and MTH2-V4 Instructions for Use
5. European Standard EN 1073-1, January 1998, "Protective Clothing Against Radioactive Contamination"
6. Institute for Nuclear Protection and Security EC Type Examination Certificate No. 0073 / 197 / 162 / 01 / 96 / 0001 (Delta Protection MTH2 suits)
7. 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

## **Assessment of Delta Protection Supplied-Air Containment Suits**

### **Enclosure 1**

8. Institute for Nuclear Protection and Security EC Type Examination Certificate No. 0073 / 197 / 162 / 12 / 97 / 0028 (Mururoa V4F1)
9. Test Results Carried Out on the Full Encapsulated Suit Mururoa V4F1 Ref: 8481X1T for the EC Type Examination Certificate No. 0073 / 197 / 162 / 12 / 97 / 0028



## Anti-Contamination Suit



### DESCRIPTION

Encapsulating, one-piece, single/multi use, supplied-air, positive pressure anti-contamination suit with either remote or portable ventilation. This suit has been developed for the nuclear industry.

### FEATURES & BENEFITS

#### Materials & Design

- Durable chemical resistant PVC, or polyethylene (available with fire-retardant treatment).
- MTH2 suit can be incinerated.
- Reinforced elbows, knees and crotch for increased durability.
- Dual zipper system – metal zipper plus a PVC zipper – provides mechanical strength and gas and liquid impermeability.
- Transparent PVC hood with distortion-free visor gives 180 degree field of vision.

#### Ventilation

- Air flow is user selectable from 9-43 cfm (40-85 PSIG) to adapt to different cooling and breathing needs.
- Integrated manifold system distributes air throughout the suit to remove metabolic heat and keep visor from fogging.
- Ideal for use in hot environments, such as steam generator jumps, reactor vessel decon Rx Cavity and all fuel cycle applications etc.
- Manifold system maintains low noise levels: <78 dBA at 43 cfm.
- Two patented exhaust valves eliminate the possibility of entry of airborne contaminants in case of loss of supplied air or if certain body movements create a sudden negative pressure.



Mururoa V4 F1



MTH 2

#### Comfort and Ease of Use

- High Speed donning and doffing.
- Full body cooling increases stay times
- Eliminate PCE's
- Available with portable fan and filters for situations where a supplied-air line is impractical.
- Integrated overshoes and PVC gloves make suiting up easier and eliminate potential leakage points. This is a no compromise fully encapsulating approach to protection, and comfort.

#### Respiratory Protection

- Air-borne Protection Factor in excess of 50,000 for flow-rates from 9 CFM to 43 CFM
- Certified to EN 1073-1 Class 5 PF > 50,000.

#### Safety Features

- One to three minutes of breathable air in the suit in case of failure of air supply.
- Tear-away strip running from wrist to wrist permits emergency doffing of suit in less than 5 seconds, as well as easy removal of the suit preventing cross contamination.
- Tear-away strip in front of the mouth permits emergency breathing.

#### Approvals

- Has been tested and certified to EN 1073-1 "Supplied air suits for protection against Radioactive Contamination"..
- Application tested and NRC approved..

#### •Sperlan Protection Clothing

- 4200 St. Laurent BLVD Montreal, Quebec H2W-2R2
- 1-514-236-5036 Phone
- 1-514-282-8871 FAX

N°: Do / USA / 1	<b>MURUROA</b> <b>V4 FULLY ENCLOSED SUIT</b>  <b>GENERAL DESCRIPTION</b>	 <b>DELTA PROTECTION</b> ☎ 04 66 89 18 36
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## 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"

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**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

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## **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.

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**GENERAL CONSIDERATIONS**

THE MURUROA SUIT IS AVAILABLE IN SIX SIZES

Size 0	1,55 m	→	1,62 meter	5 feet 1 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° - 131°F) depends on air fed temperature

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**MATERIAL PROPERTIES**

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

<b>Characteristic</b>	<b>Standards</b>	<b>Results</b>		<b>Units</b>
Density	NFT 51063	1.38		gm/cm <sup>3</sup>
Traction Resistance	NFT 54102	≥ 143		N/cm <sup>2</sup>
Stretch before tear	NFT 54102	≥ 178		%
Tear resistance	NFT 46007	≥ 45		N/cm <sup>2</sup>
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/m <sup>2</sup> /24h
Volatility on activated charcoal	NFT 51167	≤ 6		%
Spark perforation	NFC 26225	9.2		KV

N°: Do / USA / 2	<b>MURUROA</b> INSTRUCTIONS FOR DONNING AND REMOVAL THE MURUROA V4 FULLY ENCLOSED SUIT	 <b>DELTA PROTECTION</b> ☎ 04 66 89 18 36
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**INSTRUCTIONS FOR DONNING AND  
REMOVAL THE MURUROA V4 FULLY  
ENCLOSED SUIT**

N°: Do / USA / 2	<p style="text-align: center;"><b>MURUROA</b> INSTRUCTIONS FOR DONNING AND REMOVAL THE MURUROA V4 FULLY ENCLOSED SUIT</p>	
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## **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.

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**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.

N°: Do / USA / 2	<b>MURUROA</b> INSTRUCTIONS FOR DONNING AND REMOVAL THE MURUROA V4 FULLY ENCLOSED SUIT	
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### **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.

N°: Do / USA / 2	<b>MURUROA</b> INSTRUCTIONS FOR DONNING AND REMOVAL THE MURUROA V4 FULLY ENCLOSED SUIT	 <b>DELTA PROTECTION</b> ☎ 04 66 89 18 36
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## **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 mouth strip off with either hand
- 2) Separate plastic of mouth and breath
- 3) Move to a safe area and get assistance

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## 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 its 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 85 psig)
maximum flow rate	1100 liters/min. +/- 10% at 6 Bars ; (38cfm at 85 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.

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**EUROPEAN STANDARD  
NORME EUROPEENNE  
EUROPEÄISCHE 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 Prüfverfahren für belüftete  
Schutzkleidung 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

Europäisches Komitee für Normung

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

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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.

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### **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 Particulate 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	single use materials
Abrasion resistance	6 > 2000 Cycles 5 > 1 500 Cycles 4 > 1000 Cycles 3 > 500 Cycles 2 > 100 Cycles 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 5 > 40000 Cycles 4 > 1 5000 Cycles 3 > 5000 Cycles 2 > 2500 Cycles 1 > 1000 Cycles	ISO 7854 Method B	yes	no
Puncture resistance	3 > 100 N 2 > 50 N 1 > 10 N	EN 863	yes	yes
Resistance to blocking (see note 1)	2 no blocking 1 blocking	EN 25978	yes	no
Tear resistance	6 > 150 N 5 > 80 N 4 > 40 N 3 > 20 N 2 > 10 N 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
<p>NOTE 1: Uncoated materials shall not be tested against resistance to blocking. The test report shall be marked "Not tested against....."</p> <p>NOTE 2: If protection against hazardous chemicals is required then testing has to be carried out according to the relevant chemical standards.</p>				

**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 continuous 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  $(20 \pm 2)$  °C and  $(65 \pm 5)$  % 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  $(-30 \pm 3)$  °C and allowed to return to ambient conditions, followed by
- b) for 4 h to an atmosphere of  $(60 \pm 3)$  °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  $(20 \pm 5)$  °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 15 to 20 times in 10 min .

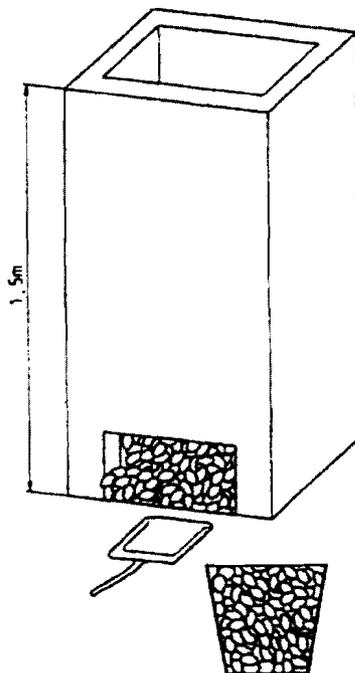


Figure 1: Hopper and basket

### 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 axially 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  $(50 \pm 2,5)$  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).

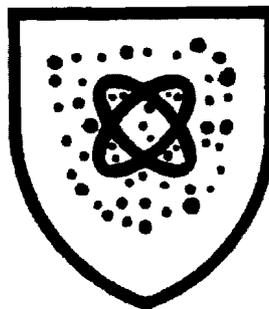


Figure 2: Pictogram

## 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.

I

**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 disperse with person in chamber	3
14	disconnect sample tubes and remove person from test chamber and undress subject	-
<p>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 .</p> <p>Analyse results over final 2 min of each exercise period to avoid carry over of result from one exercise to the other.</p> <p>Record challenge chemical continuously using a separate detector (if possible). Record the pressure inside the suit over the whole time.</p>		

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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:

<b>EU-Directive 89/686/EEC, Annex II</b>	<b>clauses of this standard</b>
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.



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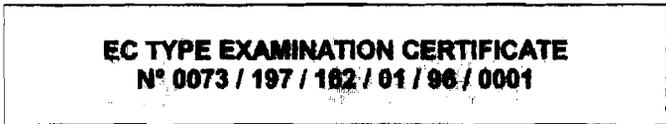
**Technical Center for Nuclear Equipment Certification**

In accordance with the directive 89/686/EEC dated December 21<sup>th</sup> 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 29<sup>th</sup> 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 24<sup>th</sup> 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23<sup>th</sup> 1994).

Assigns the :



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 / RED I – 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 10<sup>th</sup> 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

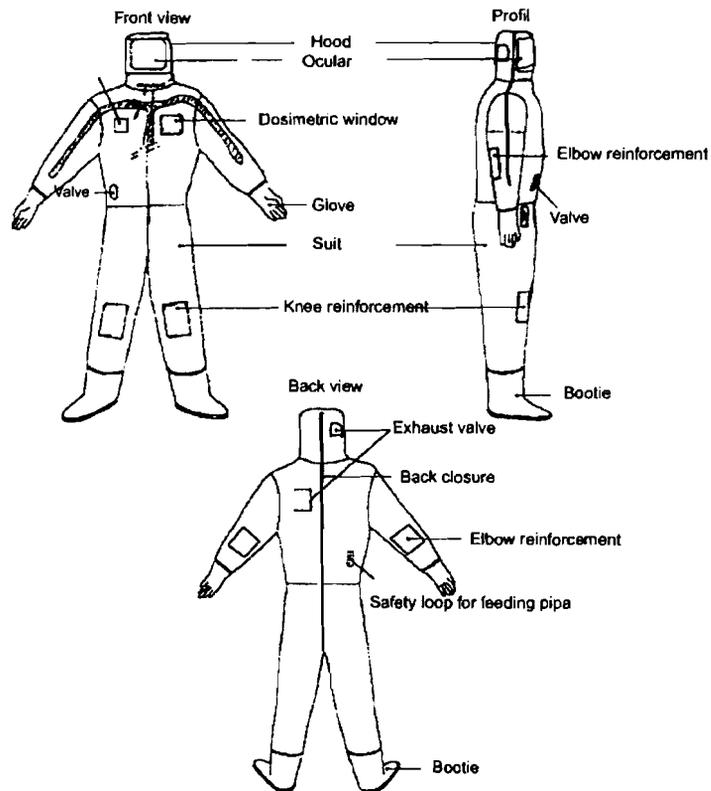
It is a Ventilated Protective Suit against Radioactive Contamination ventilated type – pressurised for a single use only, its name is:

### 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 9-9½, 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.

**2.1.2. 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:  $30 \text{ m}^3 \cdot \text{h}^{-1}$  ( $500 \text{ l} \cdot \text{min}^{-1}$ ) for a 6 Bar supply pressure  
Maximal flow rate:  $66 \text{ m}^3 \cdot \text{h}^{-1}$  ( $1100 \text{ l} \cdot \text{min}^{-1}$ ) 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<sub>2</sub> 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<sup>3</sup>.h<sup>-1</sup> (500 l.min<sup>-1</sup>)
- **Maximum air flow rate:** 66 m<sup>3</sup>.h<sup>-1</sup>.(1100 l.min<sup>-1</sup>)

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 for this equipment in accordance with the Essential Requirements of the European Standard pr EN 1073-1 (revision Nov 1995). Other results that are not pointed out in this report are already written in the EC TYPE Examination certificate (dated December 10<sup>th</sup> 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)**

<b>Suit number</b>	<b>Entrance valve position</b>	<b>Air flow feeding pressure Bar / psig</b>	<b>air flow (m3/h / l/mn/ cfm)</b>
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)**

<b>Suit number</b>	<b>Feeding pressure Bar / psig</b>	<b>Air flow M3/h / cfm</b>	<b>CO2 contents(%)</b>
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)**

<b>Suit number</b>	<b>Feeding pressure Bar / psig</b>	<b>Air flow M3/h; cfm</b>	<b>Noise level (dB)</b>
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°	1	2
<b>Exercise</b>		
<b>Air flow m3/h/ l/mn / cfm</b>	30 / 500 / 17	31 / 516 / 18
<b>Standing still</b>	130 000	130 000
<b>Walking ( 5 km/h)</b>	59 500	50 000
<b>Moving arms up and down above head</b>	125 000	125 000
<b>Continuous squats</b>	65 000	81 250
<b>Bending forward</b>	100 000	92 850
<b>Person twisting at waist</b>	115 000	130 000
<b>Standing still</b>	130 000	130 000
<b>Average</b>	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°	1			2		
Exercise	P ave/ P min/ Pmax daPa.			P ave; P min, P Max. daPa		
<b>Standing still</b>	40	-	-	38	-	-
<b>Walking ( 5 km/h)</b>	40	23	74	100	61	128
<b>Moving arms up and down above head</b>	40	17	62	46	18	72
<b>Continuous squats</b>	42	4	86	56	3	110
<b>Bending forward</b>	52	3	104	74	0	162
<b>Person twisting at waist</b>	38	18	58	46	20	110
<b>Person crawling</b>	37	-	-	40	-	-

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

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

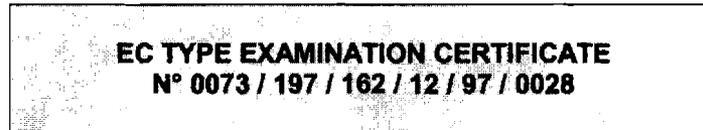
**INSTITUTE FOR NUCLEAR PROTECTION AND SECURITY****Technical Center for Nuclear Equipment Certification**

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 29<sup>th</sup> 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 Employment and Agriculture dated December 24<sup>th</sup> 1996.
- Identified under the n° 0073 (published in the EEC Official Publication dated July 23 th 1994).

Assigns the :



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 10<sup>th</sup> 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

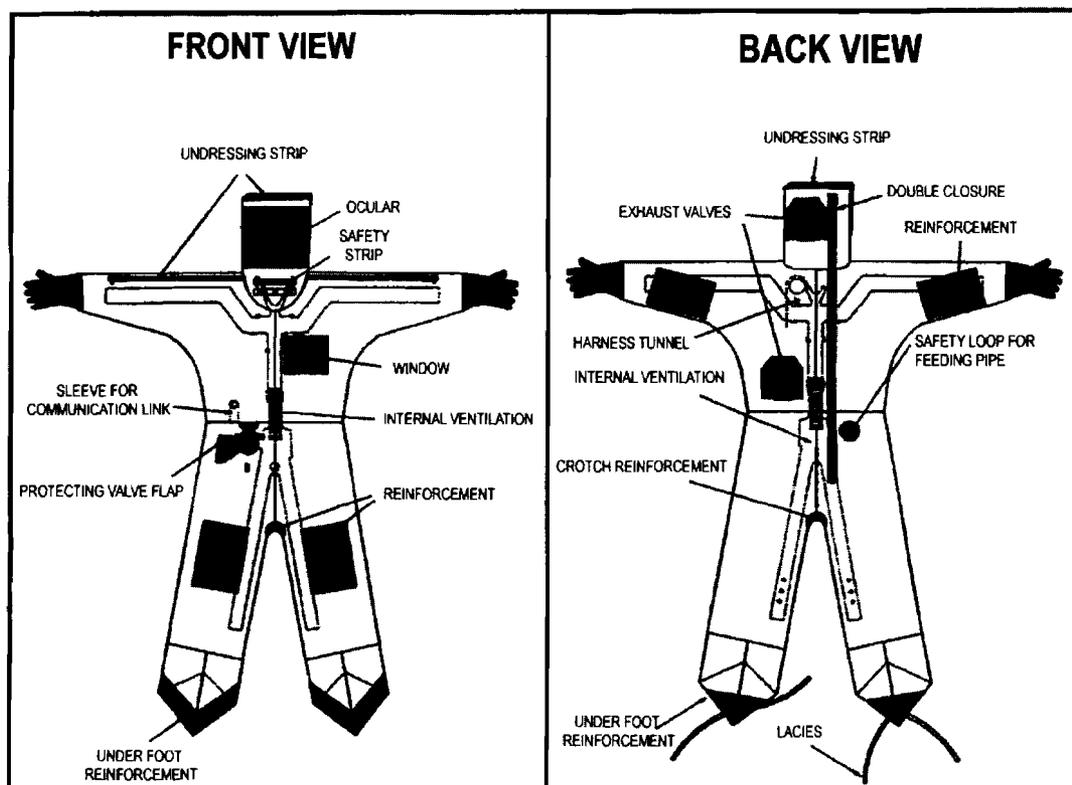
The T values are defined according to the size of the suit.

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 9-9 1/2 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 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 Imegs.
- 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.

#### 2.1.2. Flexcracking 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 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<sup>3</sup>.h<sup>-1</sup> (500 l.min<sup>-1</sup>)
- Maximum flow rate : 58,4 m<sup>3</sup> h<sup>-1</sup> (973 l.min<sup>-1</sup>)

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

$$D_{\min} = 27,0 \text{ m}^3 \cdot \text{h}^{-1} \text{ (450 l} \cdot \text{min}^{-1}\text{)}$$

$$D_{\max} = 64,2 \text{ m}^3 \cdot \text{h}^{-1} \text{ (1070 l} \cdot \text{min}^{-1}\text{)}$$

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 ( $D_{\min}$ ), when the valve is on the "stop" closed position.
- Superior to the maximum value estimated by the manufacturer ( $D_{\max}$ ), 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 following 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 distortion 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 exceed 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 CO<sub>2</sub> 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 different 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<sup>TH</sup> 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.

These documents will be corrected in order to take into account the tests results as mentioned 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<sup>3</sup>.h<sup>-1</sup>.**
- **Maximum air flow rate: 64,2 m<sup>3</sup>.h<sup>-1</sup>.**

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

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 10<sup>th</sup> 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°	1	2	3
<b>Exercise</b>			
<b>Standing still</b>	> 120 000	> 120 000	> 120 000
<b>Walking ( 5 km/h)</b>	76 700	90 900	66 000
<b>Moving arms up and down above head</b>	113 800	> 120 000	113 800
<b>Continuous squats</b>	30 000	41 700	50 000
<b>Bending forward</b>	110 000	103 400	91 700
<b>Person twisting at waist</b>	> 120 000	> 120 000	> 120 000
<b>Person crawling</b>	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.
<b>Standing still</b>	275	280	295	305	275	280
<b>Walking ( 5 km/h)</b>	200	800	300	900	600	900
<b>Moving arms up and down above head</b>	150	400	160	420	250	800
<b>Continuous squats</b>	30	900	30	1050	70	1700
<b>Bending forward</b>	80	1550	60	1900	100	1900
<b>Person twisting at waist</b>	140	500	160	420	160	650
<b>Person crawling</b>	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.

## List of Regulatory Commitments

### Enclosure 2

The following list identifies those actions committed to by SNC in this document. Any other statements in this submittal are provided for information purposes and are not considered regulatory commitments. The commitments listed below will be completed prior to using the Delta Protection suits for respiratory protection.

	REGULATORY COMMITMENT	DUE DATE
1	The manufacturer's instructions for use and storage of the Delta Protection Mururoa V4F1 and V4 MTH2 suits will be integrated into SNC respiratory program.	Upon implementation of NRC approved use of the Delta suits for respiratory protection
2	Lesson plans will be developed and used to train workers and radiation protection technicians on the Delta Protection Mururoa V4F1 and V4 MTH2 suit features, donning, use and removal, and use of mouth strip and tear off strips for routine and emergency egress.	Upon implementation of NRC approved use of the Delta suits for respiratory protection.
3	SNC radiation protection personnel will be provided additional training for selection, approval, issue, equipment set-up, operation and maintenance instructions for the Delta Protection Mururoa V4F1 and V4 MTH2 suits.	Upon implementation of NRC approved use of the Delta suits for respiratory protection.
4	The Delta Protection Mururoa V4F1 and V4 MTH2 suits will be discarded after a single use and will not be used in atmospheres that are immediately dangerous to life and health (IDLH).	Upon implementation of NRC approved use of the Delta suits for respiratory protection.
5	Any defects discovered will be entered into the SNC Corrective Action Program and reported to the manufacturer, as necessary. Industry notifications, when required, will be made through the Operating-Experience Program.	Upon implementation of NRC approved use of the Delta suits for respiratory protection.