Introduction to Darchem Thermal Protection

Darchem Thermal Protection is a strategic division of Darchem Engineering and is a world leader in the design, manufacture and installation of thermal insulation systems for the Nuclear Industry.

From the first bespoke insulation supplies to the UK’s fast breeder reactor research program in 1958, Darchem Thermal Protection has developed and supplied insulation systems for nuclear power plants such as gas cooled reactors, advanced gas cooled reactors (AGR), Sodium cooled fast reactors (SFR), helium cooled reactors (HTHR), boiling water reactors (BWR) and pressurised water reactors (PWR).

Darchem Thermal Protection is continually innovating its products to meet the varying technical demands of the latest generation of nuclear new builds. Corporate investment has created a state of the art nuclear insulation test facility with full scale representations of primary circuit equipment, pipeline and components for insulation thermal performance testing. This has placed Darchem thermal protection at the forefront of insulation type and system design evaluations for the generation III+, AP1000 and EPR insulation supplies.

Darchem Thermal Protection’s pedigree in the design and manufacture of passive fire protection systems has extended its nuclear portfolio into the fire protection of safety critical equipment and electrical raceways.

Quality and Environmental Accreditations
Darchem Engineering holds BS EN ISO 9000 together with a wide range of specific company approvals from our worldwide customer base.

The company is environmentally accredited to BS EN ISO 1400 and is committed to continuous improvement in preventing and reducing pollution together with minimising the environmental impact of our activities, processes and services.
Nuclear Testing Capabilities

Darchem Thermal Protection are continually innovating its products to meet the varying Technical demands of the Latest Generation of nuclear new builds. Corporate investment has created a state of the art Nuclear Insulation test facility with full scale representations of Primary Circuit Equipment, Pipeline and Components for Insulation Thermal performance testing.

This has placed Darchem Thermal Protection at the forefront of Insulation type and system design evaluations for the Generation III+, AP1000 and EPR insulation supplies.

Thermal testing can be carried out on our new 2.38m wide by 3m high vertical flat plate rig to represent a large vessel system or the rig can be rotated to a horizontal orientation to offer alternative testing configurations.

Testing of the load bearing insulation system used in areas deemed to have “through foot traffic”
Thermal testing can be carried out on a 30 inch diameter pipe rig to represent a typical Primary Circuit Pipe.

Water spray testing to demonstrate compliance with specification requirements regarding ingress of water and drainage capabilities.

Test data from previous large scale representations is also used in the Thermal justification documents.
Compliant with NRC Guide 1.82 and 1.36. Tested to International Standard ASTM C236-89

Darchem Engineering’s Reflective Metal Insulation (RMI) DARMET™: an all-metallic insulation system designed to control the heat loss and temperature gradients on primary circuit vessels and associated equipment and pipework.

DARMET™ is currently installed in over 150 nuclear power plants worldwide.

DARMET™ is a fully engineered all metallic construction in austenitic stainless steel with excellent performance characteristics.

Reduced heat-losses, lower containment air temperatures and fewer equipment operational difficulties are the hallmarks of its capability.

DARMET™ offers multi-functional capability in its thermal performance, strength and structural aspects, removability features and through-life durability without environmental or Health and Safety problems.

DARMET™ will maintain design performance for the life of the plant, therefore eliminating the need for replacement materials and reducing the future cost of plant ownership.

Reactor Pressure Vessel insulation with DARMET™ is designed and fitted prior to vessel installation to provide long-life performance without deterioration.

There are a number of principle features of DARMET™ which provide it with an overall superiority to conventional fibrous insulation systems.

Removability and Replacement
Being an engineered system, the ease of removability and replacement of DARMET™ can be varied in accordance with the requirements of a particular application. Therefore, for in service inspection or maintenance, the panels can be designed so that they can be removed in less than a minute. This rapid operation reduces radiation exposure times, reduces labour and material costs and downtime of equipment.

Corrosion Resistance
The DARMET™ system is generally constructed from austenitic stainless steel. Darchem Engineering has not encountered any situation where it has corroded in nuclear environments since its introduction to the UK’s Fast Breeder Reactor research program in 1958.

DARMET™ does not become radioactive when irradiated, making disposal or recycling easier at the end of the plant’s life. DARMET™ can be decontaminated if required. The self-draining all-metallic insulation can be washed down to remove any surface contamination and compared to fibrous solutions, offers ease in maintenance, removal and refitting.

No Health Risk
DARMET™ all-metallic insulation contains no fibres and therefore does not contribute to the risks associated with the ingestion of contaminated airborne particles by maintenance personnel. Within some countries fibrous insulation materials are considered to be a class 2 carcinogen.

Drainability
The exterior of DARMET™ is water shedding. It is self-draining. Its thermal performance is therefore unaffected by water and does not hold chloride in contact with the pipework, unlike fibrous insulation which quickly slumps when wetted.
**DARMET™**

**Performance**

DARMET™ designed panels provide as close a fit as possible to the pipe or vessel being insulated. This means that on vertical risers the design severely restricts any “chimney effect” convection in the air gap between the hot surface and the inner skin.

DARMET™ is an assembly of thin gauge stainless steel foils in factory made cassettes, which have been specifically designed to minimise heat loss that occurs through conduction, convection and radiation.

DARMET™ all metallic insulation systems are neat, compact and clean in the most complex of arrangements.

**DARMET™ works by:**

Creating pockets of air between the alternate layers of dimple foil. The design ensures that this air is kept stagnant, thus reducing heat loss by convection.

The design of the foils reduces conduction by creating the longest possible heat paths. The layers of highly polished stainless steel foil reflect back radiated heat.

Quality of the DARMET™ product is assured by thorough inter stage inspections and the following requirements of BS EN ISO 9001:2000.

**Testing, Certification and Development**

Practical “in-service” experience is complemented by a comprehensive laboratory test programme.

An ongoing programme of product development ensures the Darmet™ continues to be the most “user friendly” thermal insulation system available.

Extensive test programmes have been carried out including:

- Thermal performance on representative large scale vessel areas.
- Thermal performance of large and small bore pipework in various orientations.
- Mechanical shock up to 300g.
- Measurement of effect on thermal performance of ageing and contamination.
- Panel robustness.
- Drainage and water spray.
- Seismic accelerations up to 5G.

**Esterline**

[Darchem Engineering](#)
DARMET SMRI provides integral radiation protection with engineered insulation. The product is a development of the well proven DARMET all metallic stainless steel thermal insulation system also produced by Darchem Thermal Protection.

Principle Features of SMRI
- Radiation reduction Exposure
- Maintains Ease of removability
- Purpose designed
- Maintains Thermally efficiency
- Designed to satisfy Seismic and LOCA criteria
- Designed to be Dust free

Reduction in Operational Time and Radiation Exposure
The introduction of DARMET SMRI significantly impacts the access time for maintenance and operational staff by permanently reducing radiation levels. Previously declared “restricted” levels can become readily accessible thus improving quality time within containment, saving at least 25-50% of dosage pick up time. Dose Reduction Feedback

Site Feedback from operational plants with DARMET SMRI fitted has shown that the dosage pick up can be reduced by 50%.

Criteria for Design
- Weight limitation due to existing supports.
- Operating Temperature of pipeline / Equipment.
- Location of Shielding within insulation.
- Environmental clashes, restrictive access.
- Thermal Performance and properties of Shielding
- Shine path limitations.
- Shield Thickness to be applied
- Shield material type

Shield Location Options

Independent Outside the Insulation Panel Assemblies

Independent to Insulation Assemblies

Integral within Insulation Assemblies
Encapsulated fibre insulation
Nuclear Industries

DARMET ENCAPSULATED Thermal Insulation System is specifically designed to minimise heat loss in various applications.

This product is installed where the requirement of LOCA (Loss of Coolant Accident) is not as stringent. The form of insulation varies from Mineral Wool to high performance insulations like micro-porous insulation. The insulation can be encapsulated in a stainless steel Panel design which will form part of an assembly encompassing the component. Alternatively the insulation can be encapsulated in a High Temperature resistant cloth material forming a mattress panel design which will form part of an assembly encompassing the component. This assembly is then covered in a thin gauge austenitic stainless steel cladding skin offering the necessary operational protection. Both systems provide simple installation and removability characteristics. Each application is designed to suit the customer specification with respect to thermal and mechanical requirements.
**KM1™ Fire Barrier Systems**

**Fire walls, Ceilings and Duct Passives Fire Protection**

KM1™ is a fire barrier system developed to provide fire rated partitions in nuclear facilities.

KM1™ is recognised by the US NRC as the only fire barrier system that does not need the fire barrier to be either partially or totally destroyed to remove it for inspection or cable laying purposes. The same KM1™ panels or sections can be re-used, saving through life costs.

The KM1™ fire barrier partition system has successfully passed fire tests up to 4 hours duration. Fire tests are fully compliant with ASTM E119 and the European EN 1363-1 firecurves.

The modular construction means that the KM1™ fire barrier partition can be easily modified to incorporate access door and service penetrations without the need for major construction work.

The system is based on a patented semi-rigid board, containing a strongly endothermic material which absorbs heat during a fire, creating an effective delay to the heat transfer mechanism in a high temperature fibre matrix.

The KM1™ fire barrier partition system has the same characteristics as the KM1™ fire barrier system for electrical equipment.

The system has been designed for ease of installation. Site installation is carried out using local labour with the minimum of training. The installed system is durable, weather proof and aesthetically appealing.

Fire tests have been at EXOVA Warrington witnessed by KHNP and successfully comply with the criteria of ASTM E119. Other tests include:

- **Ageing:** ASTM E1027
- **Combustibility:** ASTM E136
- **Corrosibility:** US Reg 1.36
- **Surface spread of flame:** ASTM E84
- **UV Resistance testing**
- **Seismic Testing**

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KM1™ Fire Barrier Systems
Electrical Raceway and Equipment
Passive Fire Protection

KM1™ is a fire barrier system developed for the protection of safety critical electrical equipment in the nuclear industry.

KM1™ is recognised by the US NRC as the only fire barrier system that does not need the fire barrier to be either partially or totally destroyed to remove it for inspection or cable laying purposes. The same KM1™ panels or sections can be re-used, saving through life costs.

The system has successfully passed fire tests ranging from 30 minutes to 3 hours in a wide range of boundary specific configurations. Boundary conditions include zero percent cable fill as well as free fall single and grouped cables. Fire tests are fully compliant with NRC Generic Letter 86-10, supplement 1 using both the ASTM E119 and the European EN 1363-1 fire curves. Testing covers the majority of potential site configurations.

KM1™ has one of the industry’s lowest ampacity derating factors for a fire barrier system of an equivalent protection duration.

The system is based on a patented semi-rigid board, containing a strongly endothermic material which absorbs heat during a fire, creating an effective delay to the heat transfer mechanism in a high temperature fibre matrix.

The system has been designed for ease of installation. Site installation is carried out using local labour with the minimum of training. The installed system is durable, weather proof and aesthetically appealing.

Fire tests have been UL, NRC and VTT witnessed and successfully comply with the criteria of US NRC Generic letter 86-10, supplement 1, UL1724, ASTM E119 and EN 1363-1

Other tests include:
- Ampacity derating: IEEE P848 dr 16
- Ageing: ASTM E1027
- Combustibility: ASTM E136
- Corrosibility: US Reg 1.36
- Surface spread of flame: ASTM E84
- UV Resistance testing
- Seismic Testing
- Water Deluge Testing
Due to the increased activity in recent years, and the necessity for increased customer support, Darchem Engineering Site Services team has been set up to provide our customers with an all round service including front end survey, final installation and after sales support. Resources are made available Worldwide to meet customer demands.

Darchem Engineering Ltd has the capability to:

- Respond to urgent fast track requirements.
- Provide after sales services.
- Co-ordinate manufacture and installation activities on critical programmes accommodating operational constraints.
- Give worldwide support.
- Provide key skilled engineers and technicians to perform design surveys, installation and training.
- Detailed pre-planning of integrated outage activities.
- Calculations of total radiation dosage for the agreed programme.
- Co-operation with on-site health, physics and maintenance personnel.
**Technical Capabilities**

The Darchem Thermal Protection Engineering Team has extensive experience in both Fire Protection and Thermal Insulation Solutions.

Our 3D CAD system enables customers to provide 3D CAD models for importing into our 3D CAD system. When the customer does not have 3D model data, the more traditional methods such as Site Surveys or customer 2D drawing data can be entered into our 3D CAD system manually.

The 3D modelling system means that we can streamline the flow of data to our customers and integrate the information into our laser cutting and manufacture facilities. This degree of engineering reduces the potential of having to carry out site modifications.

The Darchem Thermal Protection Engineering Team are highly qualified and have experience of a broad range of bespoke design solutions.

When the customer has problems that are outside the normal tested parameters, in these instances, the design provides engineering evaluations that can be verified by analysis that have been validated using prior test work or bespoke test work.

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The Darchem Thermal Protection Engineering Team has vast experience in traditional calculation methods to analysing problems. The use of Finite Element Analysis (FEA) & Computational Fluid Dynamics (CFD), provides accurate analysis to customer problems. The business unit continually looks to use technology to provide innovative solutions.