

## A. Next Generation Emission Abatement Technology

| No | Technology Owner   | Project Description  | Applicable Industries   |
|----|--|--|---|
| 1  | CPPE Carbon Process & Plant Engineering S.A. (Luxembourg, Europe) & Fraunhofer IGB | <b>CoalCO<sub>2</sub>-X Program</b><br>Conversion of CO <sub>2</sub> that originate from coal-fired power plants into multiple commodity streams using Green Ammonia and Green Hydrogen. | Combustion Installations, Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass, Metallurgical Industry, Mineral Processing, Storage and Handling, Disposal of hazardous and general waste, Pulp and Paper Manufacturing Activities, including By-Products Recovery |

## B. Proven Proprietary Emission Abatement Technology

| No | Technology Owner  | Project Description   | Applicable Industries   |
|----|---|---|---|
| 1  | CPPE Carbon Process & Plant Engineering S.A. (Luxembourg, Europe) | <b>Activated Carbon Multi-Pollutant Abatement Technology</b><br>CPPE partnered with EPCM Global to bring activated carbon based multi-pollutant emission abatement technology to Africa. The CPPE technology is proven, simple, reliable and sustainable as it enables various industries to comply with emission legislation limits now and into the future. | Combustion Installations, Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass, Metallurgical Industry, Mineral Processing, Storage and Handling, Disposal of hazardous and general waste, Pulp and Paper Manufacturing Activities, including By-Products Recovery |

## C. Business Cases & Frameworks for New Technology Development Programs

| No | Client / Company | Project Description  | Industry                  |
|----|------------------|--|---------------------------|
| 1  | PBMR (Pty) Ltd   | <b>Developing and Evaluating a Complex Business Case for the PBMR Fuel Manufacturing Technology within the RSA Context</b><br>Developed a position paper for the strategic positioning of PBMR Fuel Manufacturing Technology within the broader South African context. The paper was presented and agreed to by both the NECSA and PBMR Boards. Executive responsibility for the development and implementation of a Fuel Operations Readiness program. Responsible for negotiating and contracting of all Nuclear Feed Material (Uranium) for the commissioning and early manufacture of PBMR Fuel.                                       | Nuclear -Power Generation |
| 2  | MTN South Africa | <b>Implement the new product design and delivery process recommendations arising from a strategic change management intervention</b><br>Defined and structured the New Product Development (NPD) project to fully define and implement the new product design and delivery recommendations to implement and sustain the new product innovation, product design and delivery process for MTN-SA. Led a joint MTN team to ensure the foundation product design and delivery best practices and processes were defined, developed, rolled-out and established to enable MTN-SA to fully exploit the benefits to be had from a streamlined and | Telecommunications        |

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|   |                | integrated product design and delivery process based on new product development best practices.  |                        |
| 3 | PBMR (Pty) Ltd | <p><b>Developing and Evaluating Complex Business Case for the Nuclear Process Heat Plant for Hydrogen Generation</b></p> <p>Headed the initial study on the Nuclear Heat Process Plant design for Hydrogen generation and other High Temperature Applications. Development of the PBMR Technology Growth Path. Participated in a consortium with other International Companies in a bid for a Department Of Energy (DOE) project on Co-generation plants for the USA. The consortium was successful in its bid. Managed the Licensing project of PBMR with the NRC in the USA.</p> | Nuclear – Process Heat |

## D. New Product & System Development

| No | Client / Company                              | Project Description  | Industry                  |
|----|---|--|---------------------------|
| 1  | Armaments Corporation of South Africa SOC Ltd | <p><b>Commercialisation of Dual-Use Technologies and Intellectual Property (IP)</b></p> <p>Identification, listing and prioritisation of dual-use IP and technologies for commercial application in terms of 1, 5 &amp; 10-year pipeline. Commercialisation &amp; funding framework, business models, launch client engagements, business cases and support with implementation</p>  | Defence                   |
| 2  | North-West University                         | <p><b>Due Diligence on the Commercialisation of Complex Intelligent Ignition Technology</b></p> <p>Part of a panel of experts performing a due diligence with specific reference to project &amp; systems engineering management aspects on a project to commercialise complex internal combustion engine technology intended for global engine manufacturers.</p>   | Automotive                |
| 3  | Milotek (Pty) Ltd                             | <p><b>Development of a Demonstration Model for a novel Transportation System</b></p> <p>Project and systems engineering management for the design of a demonstration unit for a battery-operated transportation system. Delivery of manufacturing data packages ready for manufacturing.</p>   | Transportation            |
| 4  | Eezi Lite Solutions (Pty) Ltd                 | <p><b>Design, Construction &amp; Commissioning of a Factory to Produce a New Charcoal Product to the RSA Market</b></p> <p>Executive responsibility for the production and plant optimization of a charcoal briquette manufacturing and impregnation plant. Owners Team responsibility successfully fulfilled for the construction, commissioning and early operations of a 15ton/day plant.</p>   | Leisure                   |
| 5  | AREVA NP GmbH                                 | <p><b>Breakthrough Development, Qualification &amp; Manufacturing of Nuclear Instrumentation</b></p> <p>Technology scanning and testing to identify a suitable technology platform. Concept, basic &amp; detail design &amp; testing of five different product variants. Full integration of nuclear instrumentation into the power plant instrumentation &amp; control architecture. Qualification of equipment &amp; packaging to international nuclear standards. Liaison with the Finish regulator (STUK), Finish client (TVO), German third party assessor (TÜV SÜD), French main contractor (AREVA SAS), German engineering house (AREVA GmbH), German (KSR Kübler) &amp; American (Meggit) manufacturing companies. Setup of manufacturing facilities</p> | Nuclear -Power Generation |

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|    |                             | and qualification of manufacturing processes & equipment to international standards. Manufacturing, packaging, installation of equipment at the Finland Nuclear Power Plant  |                           |
| 6  | PBMR (Pty) Ltd              | <b>Setup and Management of a Nuclear Mega Project – PBMR Fuel Manufacturing Plant</b><br>Headed up the PBMR Fuel Plant (PFP) project responsible for the design, manufacture, construction, commissioning and early operations of the plant. Obtaining a Nuclear License from the NNR. Total project team consisted of 150 permanent employees, 120 contractors with a peak project load of approximately 1200 persons during construction. Responsible for controlling the project; schedule, costs, quality and reporting to the PBMR board. | Nuclear -Power Generation |
| 7  | PBMR (Pty) Ltd              | <b>Engineering Management of the PBMR Main Power System thermo-hydraulic design</b><br>Management of a group of 120 engineers and specialist supporting companies to design the PBMR thermo-hydraulic circuit. Responsible for all design work, testing and licensing activities.  | Nuclear -Power Generation |
| 8  | North-West University (NWU) | <b>Re-design, Testing, Qualification and Full scale manufacturing of PHP-X50 Ozonators</b><br>Structuring and managing a project to re-design Ozonators from the Physics department at the University using industry experts. Planning and executing CE and ISO product certifications. Setup mass production facilities and all quality documentation to enable high quantity production. Planning and execution of all pre-qualification and qualification testing. Delivery of a qualification & manufacturing baseline.                    | Leisure – Spa Baths       |
| 9  | First National Bank         | <b>Patenting, Design, Development of Mobile Banking Systems for Rural Payments</b><br>Requirements analysis, design & testing of various demonstrators, field testing, design updates, patenting, setup for mass-production, preparation and submission of qualification & manufacturing baseline documentation.   | Banking                   |
| 10 | Various Farmers in RSA      | <b>Design and Development of Cellular Monitoring &amp; Control Systems</b><br>Design, development, testing and manufacturing of cellular monitoring and control systems. Installation of demonstration units at launch clients. Design updates and optimisation, setup of manufacturing facilities. Delivery of the manufacturing baseline documentation.  | Agriculture               |

## E. Development, Construction & Commissioning of FOAKE Test Facilities

| No | Client / Company | Project Description  | Industry                  |
|----|------------------|--|---------------------------|
| 1  | PBMR (Pty) Ltd   | <b>Construction, Commissioning and Operation of the PBMR Helium Test Facility</b><br>Design of the Helium Test Facility located at Pelindaba with IST Nuclear. The facility was designed to operate with Helium at 90Bar(g) and max temp of 1100 degC. Working with IST Nuclear to execute a First-of-A-Kind Engineering (FOAKE) project. Successfully completed the construction, commissioning and early operation of a High | Non-Nuclear Test Facility |

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|   |                | Temperature, High Pressure Helium Test Facility. Establish an operational business unit and achieve operational readiness to enable the hand-over of the Helium Test Facility and operate the plant on a 24/7 basis at Pelindaba. Development of the Operational Readiness Plan. Establishment of core & supporting functions, processes and teams for testing, plant technical support, engineering, operations, logistic support and systems, safety administration & visitor liaison. Full integration between site operations and head office was achieved. Appointment of 42 operational personnel ranging from Engineers, Operators and Artisans. Process definition for ISO 9001 certification. Initial test work was done. Operational readiness & plant hand-over achieved within 2 years. One year successful operation, exceeding of test targets, 100,000 safe working hours, ISO9001 certification obtained |                           |
| 2 | PBMR (Pty) Ltd | <b>Design, Construction &amp; Commissioning of High Pressure and High Temperature Test Facilities for the Pebble Bed Modular Reactor</b><br>Design, development, construction, commissioning & initial testing of two separate test facilities to verify and validate computer codes used for the PBMR program. The test facilities were built on the premises of the North-West University using industrial contractors. Management of design reviews, supplier selection and qualification, quality control, non-conformances etc. Managing 10 engineers and 15 contractors. Successfully commissioned the test facilities (a first in the world) within schedule and quality requirements.  | Non-Nuclear Test Facility |
| 3 | PBMR (Pty) Ltd | <b>Design, Construction, Demonstration of the Pebble Bed Micro Model Test facility</b><br>Developed the initial framework for Validation and Verification of Computer codes and models for PBMR. Based on this work the design envelope of the Test Facility was specified. Project & Systems Engineering Management Plan for the design, construction and commissioning of the Pebble Bed Micro Model Test Facility. Working with the North-West University, PMBR engineers, consultants and contractors to execute the project. The Test Facility was constructed on the premises of the University. Management of design reviews, supplier selection and qualification, quality control, non-conformances etc. Managing 30 engineers and 40 contractors. Successfully commissioned the PBMR Micro Model (a first in the world) within schedule and quality requirements.  | Non-Nuclear Test Facility |
| 4 | PBMR (Pty) Ltd | <b>Development of Multiple Test Facilities and Testing for the Validation of the PBMR Flownex Thermo-Hydraulic code</b><br>Four modular experimental facilities comprised of the “volumes”, “network”, “transient” and “heat exchanger” facilities were designed, manufactured and commissioned. An instrumentation and data acquisition system was designed capable of capturing high resolution data in the millisecond range to measure shock waves. The facilities were constructed in an industrial area, tests were completed, the facilities were dismantled and re-assembled and commissioned at the Vaal Technikon. Training was provided to University staff on the operation of the facilities.   | Non-Nuclear Test Facility |

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| 5 | Eskom Holdings SOC           | <p><b>Design and Construction of Various Particle-Air Test Facilities to Enable the Validation of Computational Fluid Dynamic Software Code</b></p> <p>Design, development of multiple particle-air experimental facilities capable of handling both pulverised fuel, fly ash as well as Aluminium oxide particle-air mixtures. Development of a particle feeder and dust separation systems in order to operate the test facilities in a University laboratory environment. Development of a laser particle density meter. Completion of all tests and final installation at the University of Pretoria.</p> | Power Generation |
| 6 | Columbus Stainless (Pty) Ltd | <p><b>Design and Construction of a Full-Scale Water Model for Studying the Behaviour of Stainless Steel Pouring Processes</b></p> <p>Modular design, manufacturing of a full-scale water model. Commissioning and initial testing in an industrial area. Dis-assembly, re-assembly and installation at the University of Pretoria.</p>  | Stainless Steel  |

## F. Other New Product Development Agreements

EPCM Global Engineering (Pty) Ltd currently has non-exclusive signed agreements with selected South-African Universities to commercialise their technologies.