Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to the public)

【Areas of Technologies Requested 】

(1) Accumulation of contaminated water (Storage Tanks, etc.).

(2) Treatment of contaminated water (Tritium, etc.).

(3) Removal of radioactive materials from the seawater in the harbor.

(4) Management of contaminated water inside the buildings.

(5) Management measures to block groundwater from flowing into the site.

(6) Understanding the groundwater flow.

Technology / Knowledge	
Area	Technology areas 1, 2, 3 and 4
Title	DBD Limited applied knowledge and expertise.
Submitted by	**DBD Limited**

1. Overview of Technologies

1.1 DBD Limited Engineers and Scientists possess extensive knowledge and experience gained from addressing the challenges arising from nuclear fuel processing, storage and waste management operations. This experience spans over 40 years from a wide range of global nuclear facilities. In particular, DBD staff have worked in nuclear facilities and on projects with very similar challenges to those faced at Fukushima Daiichi.

1.2 DBD are able to provide support at a strategic level, assisting to develop and implement strategies for integrated waste management and decommissioning. DBD staff are adept at providing innovative solutions to difficult problems and this is complimented by the use of our Multi Attribute Decision Analysis tool, D_2O ©. The tool brings a rigor to the decision analysis process resulting in clear and optimum solutions, which can be applied to projects at conception, design or operational stages. DBD is also able to provide support to technology selection, based on an assessment of Technology Readiness Levels (TRL).

1.3 DBD has provided the UK nuclear industry in managing high risk materials within congested nuclear sites and DBD is well placed to provide and apply this expert knowledge to Fukushima Daiichi's contaminated water issues.

1.4 DBD Limited has already established strong links with Japan and is providing support to other facilities.

1.5 DBD has a strong network of supporting partner organization in the UK And globally, to broaden our offering to include additional services such assurance, programme management, inspection, licensing, safety assessments, PRA etc. Our international business portfolio provides us with a strong appreciation of the cultural, linguistic and business interactions necessary to provide successful outcomes.

1.6 Examples of DBD Limited's expertise and capability include:

1) Knowledge of radioactive liquid clean up operations using (**Technology area 2**):

   a) Ion exchange.

   b) Co-precipitation.

   c) Evaporation.

   d) Cross-flow micro filtration.

2) Use of self shielded systems to minimise shielding effects in liquid clean up operations (**Technology areas 1 and 2**).

3) Waste management processes to stabilise waste concentrates arising from liquid clean up (**Technology area 2 and 3**).

4) Environmental assessment impact and liquid effluent discharges for low active liquid (**Technology area 1, 2, 3 and 4**).

5) Experience and expertise concerning limitations in use of stainless steel for liquid effluent storage and treatment operations (**Technology area 1**).

6) Capabilities for remote handling and remote delivery of reagents to inaccessible and high radiation dose areas. Possible applications in sealing leak areas (**Technology area 1 and 4).**

7) Tritium handling capability arising from historic preparation of tritium designs and processing plant for Tritium Laboratory at KIT (**Technology area 2**).

8) Good working relationships with KIT leading to the possibility of collaboration between KIT and DBD Limited for the application of CECE process for concentration of tritium from tritiated water and for tritium storage in uranium getter beds (**Technology area 2**). Note; the process for ITER involves small quantities of water compared to the massive volumes that the Fukushima challenge poses.

9) Experience in design of tritium laboratories and the processing facilities as well as conceptual studies associated with fuel management operations for a commercial fusion reactor (**Technology area 2**).

10) Access to tritium handling and operational experience from the operation of JET's tritium active operation phase via Culham Centre for Fusion Energy and through former technical leaders of the JET facility (**Technology area 2**).

11) Use of High Gradient Magnetic Separation process for collecting paramagnetic particles that might be adapted to harbor waste cleanup (**Technology area 3**).

2. Overview of Knowledge

Within DBD Limited, our senior engineers possess a wealth of experience in designing and developing many aspects of nuclear fuel reprocessing and waste management plans. Some of these experiences are briefly outlined below:

1) Design and project management activities for placing 3 off 400 tonne mobile shielded waste retrieval units on the Magnox Swarf Storage Silo (MSSS) to retrieve the active waste for reprocessing.

   This major project required building re-enforcement and substantive civil engineering analysis to ensure the building integrity is maintained under new loads. The arrangements also needed to minimise the potential for contamination to escape from silo storage wall cracks.

2) Conception, design and safety case work to supply an ion exchange system in a disused fuel storage pond so that the dose rates and effluent discharge arrangements for the pond remain as low as reasonably possible.

   The use of a submerged ion-exchange system provides cost effective solutions to the Post Operations Clean Out (POCO).

3) Design and development of Sellafield's Enhanced Actinide Removal Plant (EARP) to remove traces of alpha-activity from site effluent discharges and from highly active evaporator concentrates.

4) Studies for a final downstream ion exchange process to polish Sellafield's Site Ion Exchange Plant (SIXEP) outflow during POCO using self shielded ion exchange cartridges.

5) Design and delivery of Sellafield's low active effluent monitoring and discharge facilities.

6) Preliminary design of the Rokkashomura first generation highly active evaporator facility (HALWC).

NB/ Please see the Appendix for relevant case studies.

Glossary of Terms

MSSS Magnox Swarf Storage Silo (MSSS) was built by Sellafield Site to accommodate the swarf waste produced by fuel decanning operations prior to reprocessing,

JNFL Japan Nuclear Fuel Limited.

KIT The Karlsruhe Institute of Technology (KIT) is one of the largest and most prestigious research and education institutions in Germany. The Institute for Technical Physics (ITP) at KIT operates the European Tritium Laboratory Karlsruhe (TLK), a semi-technical scale facility for processing tritium.

CECE Combined Electrolysis Catalytic Exchange (CECE) combines an electrolysis cell with a trickle bed column packed with a hydrophobic platinum catalyst. The process can efficiently separate hydrogen isotopes.

ITER International Thermonuclear Experimental Reactor (ITER) is an international nuclear fusion research and engineering project, which is currently building the world's largest experimental tokamak nuclear fusion reactor at the Cadarache facility in the south of France. Tritium is one of the isotopes used to fuel the fusion reaction and ITER have invested in tritium research through KIT.

JET JET, the Joint European Torus, is a magnetic confinement plasma physics experiment located in Oxfordshire, UK. Its main purpose is to open the way to future nuclear fusion experimental tokamak reactors such as ITER.

EARP This facility supports plants associated with both Thorp and Magnox reprocessing. It provides the means for the removal of radioactive components from liquid waste streams.