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

Technology Information	
Area	Option 1 (Select the number from "Areas of Technologies Requested")
Title	Accumulation of contaminated water (Storage Tanks, etc.)
Submitted by	Energy*Solutions* Services Inc.

1.0 Introduction; Summary of the Problem

The existing tanks located at the Fukushima site will need to be safely removed from their location and stored. To accomplish this, proposed technology to assist with the removal of the bolted type of tanks should meet:

- Swift removal of the disassembled (old) tanks,
- Timely and efficient processing techniques with minimal radiation exposure to personnel,
- Material must be stored in a confined area on site.

1.1 Overview of the technology

Energy*Solutions* does not propose an offering for new tanks as tank manufacture as an indigenous supply chain is readily available. However, decontamination, treatment, recycle, storage and disposal are a core focus of our business. Technology featured to facilitate this includes decontamination and machinery for dismantlement, compaction, shredding, and metal melt. For decontamination, we offer a number of viable treatment solutions to assist with the process.

Products for decontamination include;

- **Supercritical fluid decontamination** of nuclides from porous materials such as silts and soils is a patented process developed by Energy*Solutions*. Supercritical fluids have the solvent properties of a liquid and the diffusion properties of a gas. This makes them ideal candidates for the sequestration of nuclides from porous materials, such as contaminated soils under tanks. Patent attached Appendix 1.1.
- **Biodecontamination** is an Energy*Solutions* developed and patented process for the passive decontamination of highly radioactive concrete structures. A gel of sulphur oxidizing bacteria and food source are sprayed remotely on to a structure and over time the bacteria deliver sulphuric acid to the cement contaminated matrix at binding micro-sites exfoliating it for subsequent removal by remote vacuum techniques. This is a remote, low cost solution to remediation of highly contaminated structures such as concrete tanks, reactor containment building etc Patent attached Appendix 1.2.
- **Selchem 2** decontamination is an EnergySolitions developed and patented decontamination process. It removes contamination without aggressively dissolving the substrate. The process employs re-generable organic acid so that no liquid waste is produced and it is well suited to removal of organic deposits, such as oily films on tank / pipe surfaces. Patent attached Appendix 1.3
- **Selchem 1** is an Energy*Solutions* developed and patented aggressive decontamination process suited to reactor decommissioning. It removes deposited and grown oxide films and base substrate to the desired level. The decontamination fluid is regenerated ensuring no liquid waste is produced and all secondary waste is produced in disposal compliant solid forms. Patent attached Appendix 1.4.
- **Chemical decontamination for recycle**. Energy*Solutions* operated a waste recycling facility at Oak Ridge in TN employing physical decontamination, chemical

decontamination and metal melting to produce recycled products for reuse form metallic contaminated waste, such as the Fukushima water storage tanks. Patent attached Appendix 1.5

Process equipment for volume reduction and recycle;

- **Hypercompactiion.** The Hypercompactor allows for a multi step process of compacting materials flat and then shearing them to manageable sizes. Once sized, the material can be placed in a container for storage, or melted into second life use.

  Key features of the Hypercompactors:

  - They use several stages of force application in three orthogonal directions.
  - They use shear/compactor technology to apply forces on the order of 400 to 2,000 tons.
  - They compact the material loose, achieving densities up to 70% of the solid metal.
  - They are designed to compact metallic debris up to 2” wall thickness.
  - Containers do not have to be sacrificed with the waste (although containers can be compacted, if desired).
  - They incorporate a shear capable of cutting steel plate up to 3” (80 mm) to 7” (180 mm) thick dependent on machine size.

- **Metal Melting for Recycle** begins with the separation. The metal is processed to prepare for melting by removing metal not acceptable for melt; such as aluminum, copper, bronze. The metal will also be subjected to inspection for the removal of any liquids contained in pockets of the metal. Sizing the metal is necessary before allowing direct feed into the metal bath.

  The sized metal is placed in a cart that is pre-heated to burn off any non-metallic components such as paint, plastics, or rubber. The heat also drives of any liquids and melts any lead not found during the pre-melt processing phase. Metal is then fed into the furnace where it is melted. When the desired quantity of molten metal is present in the bath, the metal feed is suspended and samples of the molten metal are obtained for analysis. (chemistry and radiological).

  Once the bath chemistry is determined to be acceptable, the furnace is inverted to allow the molten metal to flow into pre-positioned molds. Molds can be formed in a manner that allows final product use as shielding and other recycled purposes dependent upon specific needs. This option offers functional size reduction and second life opportunities prior to long term disposition.

The various treatment methods noted in this proposal represent a small portion of products and

services. The examples offered should be viewed as potential solutions for other long term efforts outside of just the removal of tanks. Looking forward, there will be a need for many contributors who work together to solve the challenges faced at Fukushima. Initial solutions may be viewed as part of a long term answer to safe remediation efforts.

1.2 Owners

The proposed technology for decontamination is patented by Energy*Solutions*.

Energy*Solutions* owns Bear Creek Operations in Oak Ridge, Tennessee occupies 44.65 acres of land on the southwestern perimeter of the DOE Oak Ridge Reservation. The site houses 142,000 ft2 of indoor space for treatment and processing capabilities, and a bonded radioactive material storage space of approximately 378,000 ft2. The facility encompasses incineration, metal smelting, compaction, decontamination, and other volume-reduction and processing methods for LLW/MLLW. Our commercial waste treatment equipment and technologies at Bear Creek include:

- The only 2 commercial LLW incinerators in the US.
- A 10-million lb. force supercompactor.
- A 20-ton, 7,200 kW electric-induction furnace for metal melting and recycling radioactively contaminated metals into shield blocks.
- Sorting, segregation, and repackaging systems and processes.

Our Bear Creek facility has handled materials from the US, Canada, the UK and Germany.

Metal Melt Operations include:

- Capacity: >10M lbs. per year .
- Products (Beneficial Reuse — All products back to nuclear industry):
    - Shield blocks.
    - Security barriers.
    - Irradiated hardware storage canister.

Compactor Operations include:

- Largest LLW compactor in US.
- A force of 10 million pounds.
- Average compaction for DAW of 6:1.

Transfer Station Operations include:

- Low Activity DAW and Metals “Commercially Certified” for Clive disposal replacing incineration and compaction.
- Speed of processing/disposition (less than 45 day average to disposal).
- Energy*Solutions* waste profiles and GSAP permits used.
- Rail delivery.
- 100% visual and radiological inspection.

Note: *Appendix material may bear reference to BNFL. BNFL was acquired by EnergySloutions in 2006.*

2.0 Technology Readiness Levels The proposed strategies rely on readily available technologies. Most decontamination products will have a 6-9 month lead time.

【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