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

Technology Information	
Area	**3** (Select the number from "Areas of Technologies Requested")
Title	Modular Units for the Removal of Cesium-137 and Strontium-90 Radionuclides from Contaminated Sea Water and Liquid Radioactive Waste at the Fukushima Nuclear Plant Site
Submitted by	OJSC "ITEM", Moscow, Russia

1. Overview of Technologies (features, specification, functions, owners, etc.)

1. The primary task solved: the modular units are intended for the removal of cesium-137 and strontium-90 radionuclides from the contaminated sea water followed by the utilization of the radionuclides in the solid form suitable for the long-term safe storage as the secondary solid radioactive waste (SRW) and the recycle of the decontaminated water into the sea basin.

Additional options available: decontamination of liquid radioactive waste (LRW) of a complex physicochemical composition, containing different macroscale chemical elements including medium- and high-level radioactive waste (MLW and HLW).

Purification of drinking and natural water from radionuclide contaminants at certified domestic facilities.

2. Brief description of the proposed technical decisions

The primary goal of decontaminating salty sea water is proposed to be achieved using the modular facility comprising the three basic units as follows:

1. Cesium radionuclides removal unit;
2. Strontium radionuclides removal unit;
3. Microfiltration unit (as an addition to Unit 2).

2.1. Basic technological principles of removing radionuclides from the contaminated salty water

Unit 1 employs the selective cesium-137 radionuclide sorption principle using the special synthesized grained inorganic sorbents;

Unit 2 uses the selective strontium radionuclides co-precipitation principle with an inorganic carrier;

Unit 3 is the standard tangential filtration unit on ceramic microfilters.

2.2. Basic technical specifications of the proposed technology

Decontamination factors from cesium-137 radionuclides attained by the selective sorption on Unit 1 are not less than 100 including the treatment of water with the trace amounts of the radionuclide. The concentrating factor of the radionuclides in question in

the secondary SRW (exhausted spent sorbents) is not less than 5000.

Decontamination factors from strontium-90 radionuclides attained by the selective co-precipitation with an inorganic carrier on Unit 2 are not less than 200 including the treatment of water with the trace amounts of the radionuclide. Final utilization of the secondary strontium-containing waste is performed by incorporating it into the cement matrix. The concentrating factor of the radionuclides in question is not less than 100.

3. The readiness level of the proposed technology

Fig. Two production filter-containers for decontaminating high salt-bearing LRW

The figure pictures two assembled filter-container units ready for shipment to a Russian radiochemical enterprise where the LWR processing is under way.

Unit 1 and all its components is 100% ready to use:

- The design and technical documentation on the filter-container units for LRW decontamination is developed in full and complies with all the Russian standards and requirements imposed on the equipment for atomic industry uses; .
- The industrial scale manufacturing of two modifications of Unit 1 is set up. Each modification includes the filter-container mounted on a rack, equipped with all the auxiliary units and necessary instrumentation, and intended for the standalone automated operation. One filtering unit is equipped with two filters. The installed piping provides for the two operation modes: in series and in

parallel. Two modifications of the unit differ merely in the external casing shield. The first modification is intended for processing low-level radioactive LRW (of the LLRW category), and the second is produced for the MLRW processing. The filters are equipped with the internal filtering cartridge loaded by the selective inorganic sorbent bed. After the filter life of not less than 5000 bed volumes of sea water is expired, the sorbent in the cartridges is dried to remove water to less than 5%; it is performed by a special technical decision implemented in the filter design. This operation allows the long-term storage of the secondary SRW (the spent exhausted sorbent) without unloading it from the filter cartridge. It significantly simplifies the radioactive waste handling and minimizes the secondary SRW quantity;

- The own semi-industrial scale production of the selective inorganic sorbents according to the original technology in the required quantity is up and running;
- The synthesized sorbents are certified for use in the atomic industry;
- The production of several inorganic sorbent modifications intended for use in the decontamination of drinking water and natural brackish water is up and running;
- All technical decisions implemented in Unit 1 were tested at the enterprises of the atomic industry of the Russian Federation. The LRW decontamination technology itself is in operation in the RF since 1987. The design with filter-containers loaded by the inorganic sorbent beds is used for the LRW decontamination in the RF since 2001;
- If a potential Customer is interested, the production prototype of the filter-container can be demonstrated during the year 2013 at any time.

Unit 2 – the technology is currently in the bench scale test phase. To date a series of runs with the simulated solutions containing the strontium-90 contaminants and the sea water chemical composition showed the decontamination factors from strontium-90 radionuclides as high as 200-500. The amount of the secondary radioactive waste did not exceed 0/1% of the feed radioactive contaminated water.

A pilot prototype of the unit for selective removal of strontium-90 from sea water by this technique can be ready for the demonstration in 60 days.

Unit 3 constitutes the standard filtering equipment and is selected by the throughput of Unit 1 and/or 2 or other technical requirements. The filters of the type are used for the LRW decontamination in the RF for a long time.

Conclusion:

The implementation of the proposed technology for the decontamination of the radioactive-polluted sea water would allow the TEPCO operator to abandon the currently used multistage reverse-osmosis system producing vast concentrate quantities to be stored in the tanks. The new technology will decontaminate the sea water from the cesium-137 and strontium-90 radionuclides to the required standards at the minimum cost and with the minimum secondary waste volume. The decontaminated water then could be released into the sea basin without an adverse environmental impact. In combination that would not only reduce the secondary SRW volume by the least factor of 50, but also result in the fundamental change in the environmental risks producing the secondary radioactive waste in the form suitable for the safe long-term storage but not the LRW concentrates forcedly residing in the tank farm.

Yours faithfully,

Roman A.Penzin
Director General
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1. Notes (Please provide following information if possible.)

- Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)

Unit 1 – the production prototype 100% ready for the demonstration at any time

Unit 2 – the pilot prototype readiness for the demonstration – 60 days.

Unit 3 – standard equipment available in the market.

Unit 1 and Unit 3 are used for the LRW processing in the atomic industry of the Russian Federation since 2001.

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- Challenges

- Others (referential information on patent if any)