

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

Technology Information	
Area	1 – Accumulation of Contaminated Water
Title	1-1 - Requirements for the welded type of tanks
Submitted by	Candu Energy Inc., SNC-Lavalin, Atomic Energy of Canada Ltd., Canadian Nuclear Partners
<p>1. Overview of Technologies (features, specification, functions, owners, etc.)</p> <p>The following is a conceptual consideration for providing a suitable storage capacity for the contaminated and filtered water on the Fukushima site.</p> <p>Technology No. 1: Welded type of tanks or horizontal type of fiberglass tanks</p> <p>The task is to provide new suitable storage capacity for the water that is stored in the suspected tanks (flanged) and to provide new space within the designated area for storage.</p> <p><u>Description</u></p> <p>By moving to petrochemical-industry tanks designed and fabricated to US standards, the global supply chain for tanks can be applied to the Fukushima challenge, essentially eliminating tank fabrication as a critical factor. We are therefore proposing to provide new welded steel tanks either to American Petroleum Institute (API) or American Water Works Association (AWWA) standards with suitable capacity. These tanks shall be installed on new foundations, surrounded by dykes (each) for approx. ½ the tank capacity. Each dyke area shall be epoxy coated. The completed tanks shall be NDE inspected and hydro tested. We are also proposing horizontal type of fiberglass tanks as described below:</p> <p>Detailed description:</p> <ol style="list-style-type: none"> 1. Total storage capacity (estimated) is approximately 250,000 tons. 2. Life of storage tanks min 10 years. 3. Average tank capacity 1,000 tons, for total of 250 tanks. 4. Estimate area 70, 000 m². 5. Each tank will be located on a slab with individual dykes sized for handling 1/3 tank volume. 6. The dykes will be epoxy lined. 7. Water quality is assumed to be diluted sea water with traces of radionuclides. 8. Each tank will be connected to an impressed current – cathodic protection. 9. Type and material of construction (see attached specification). <ol style="list-style-type: none"> a) API 650 or 620, Mild steel, above ground, welded constructions with double bottom, optional internal coating. b) API 650 or 620, above or underground, reinforced fiber glass construction. 10. Welded tanks shall be subject to 100 RT examination 11. Horizontal type of Fiberglass tanks design should be considered because for ease of fabrication and delivery, minimizing sloshing, could be installed below ground and staked to reduce real estate 12. Fiberglass tanks shall be tested for de-lamination. Surface should be subjected to “holiday - void – continuity test prior to filling. 13. Each tank shall be equipped with necessary piping (SS material) and overflow protection, 	

- instrumentation to monitor volumetric changes.
14. Beetles shall be located in the inner space between the double bottoms.
 15. Each tank shall be internally reinforced with anti sloshing barriers.
 16. To minimize the high G values base plate reinforcement and double bolting shall apply. Internal buffers and external rings should be installed to minimize shell buckling
 17. Tanks shall be prefabricating to the extent permissible by the local transportation restriction complete with grounding and lifting lugs.
 18. The constructability and schedule of installing new tank farm will be subject to a local ability to deliver tanks fully assembled, suggest complete prefabrication and delivery by barge to allow docking as close as practical to allow for roll on roll of unloading.
 19. The recommended weigh would be in the order of 35 tons, see attached table below.
 20. Local fire protection code shall apply.

Applicable standards:

Standard	Title	Description
API-620	Design and Construction of Large, Welded, Low Pressure Storage Tanks	Guide for construction of tanks with internal pressures up to 15 psig. For large tanks which are assembled in field and are used for storage of petroleum intermediates and petroleum products.
API 650	Welded Steel Tanks for Oil Storage	This document governs the construction of tanks storing hydrocarbon products at low operating pressure (up to 2.5 psig).
API-651	Cathodic Protection for Above Ground Petroleum Storage Tanks	Discussion on corrosion problems in above ground petroleum storage tanks and associated piping. Plus description of two commonly used methods of providing cathodic protection against corrosion.
API-652	Lining of Above Ground Petroleum Storage Tanks	Guide effectively limiting corrosion by lining the tank bottom, for hydrocarbon storage tank made of steel. Guidelines are given regarding lining materials, their applications, inspection of tank bottom lining etc.
API-653	Tank Inspection, Repair, Alteration, and Reconstruction	Guideline for inspection, repair, alteration, and reconstruction of above ground hydrocarbon and chemical storage tanks, made of steel. Minimum requirements for maintaining the integrity of welded or riveted, non-refrigerated, atmospheric, above ground storage tanks, are discussed.
AWWA D100-05		Welded steel tanks for water storage
AWWA D102-06		Coated Steel water storage tanks

STANDARD API TANK SIZES

US BARRELS	US GALLONS	DIAMETER	Height	Weight lbs
7,150	300,000	40'	32'	65,000
8,650	364,000	44'	32'	75,000
8,950	375,000	40'	40'	74,000
9,650	407,000	46'6"	32'	85,900
10,100	424,000	42'6"	40'	83,000
10,310	433,000	48'	32'	85,000
10,700	450,000	40'	48'	86,300
10,800	455,000	44'	40'	97,100
12,100	508,000	46'6"	40'	96,000
12,100	509,000	52'	32'	107,000

Typical tank specification:

Type A	Outdoor storage tank
Capacity (each)	1000 m ³
Diameter	12.00 m
Height	11.0 m (straight sides including fee board)
Roof slope	0.208
Internal pressure	Atmospheric
External pressure	Atmospheric
Liquid temperature	min.: 4°C, max.: 40°C
Liquid	Sea water

Materials

Plates:	ASTM, A283 Gr. C and D only
Piping, couplings, fittings, Flanges,	SS304
Coating Interior:	White epoxy type
Exterior:	Alkyd enamel
	Note: Stainless steel shall not be painted.
Standards	ASME, API, ASTM, CGSB, CSA, SSPC
Scope of supply	Tanks Shell and Roof manholes Level indicators, draw-off sumps, nozzles Access ladders with cages, handrails Two electrical grounding lugs Anchoring materials
QA Level	CSA Z299.3
Inspection and Tests	Inspection and Test Plan (ITP) Material tests ASTM V. Visual, LT, UT or RT as per API 650

Leakage tests:

Bottom roof: Air pressure or vacuum,

Shell: Water fill test

Type B

Storage tanks of 267,000 US gal. (~1000 m³) capacity, complete with accessories

Codes and Standards

ASME: II; IX; V
 API: 650
 SSPC: SP-1; SP-6

Design

Capacity: 1000 m³
 Diameter: 12.00 m
 Height: 11.0 m, incl. free board
 Type: Cone roof and cylindrical shell
 Design Liquid Level: Sea water
 Design Internal Pressure: Atmospheric (nominal)
 Design External Pressure: Atmospheric (nominal)
 Corrosion Allowance: 1/8"

Materials

Plate: ASTM A131B
 Structural Steel: ASTM A36
 Flanges: ASTM A105
 Piping: SS 304L

Cleaning and Painting

Internal: Solvent cleaning (SSPC-SP-1)
 All welds ground
 External: Commercial blast clean (SSPC-SP-6)
 Two coats of primer
 One coat of alkyd enamel

QA Level

Inspection and Tests:

CSA Z299.3,
 Material as per ASTM,
 Visual, dye penetrant UT or RT as per API 650
 Leak testing of welds (bottom, roof),
 Water fill test for shell leaks

Type C

Fiberglass reinforced plastic tanks to API 12P standard, double bottom with integrated connections.



2. Notes (Please provide following information if possible)

- *Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)*
- *Challenges*
- *Others (referential information on patent if any)*

Benefits

Welded tanks designed and installed to API or AWWA standards complete with additional inspection and testing will provide the necessary assurance to be leak proof for the life expectancy. By moving to standard tank designs used by the petrochemical industry, the global market for fabrication and delivery is made available to Fukushima.

Issues

Challenge is to provide a suitable temporary water storage capacity quickly to commence draining of suspected tanks and free the area for installing new tanks. The need to provide additional decontamination and temporary treatment, with suitable verification of removed tanks contamination and packaging for removal and disposal if required.

Scheduling; to be able to provide the storage capacity for the cooling water demand.

To capture the benefits of this approach, companies with global experience in sourcing, delivery and construction of petrochemical storage tanks coupled with an in-depth understanding of radioactive materials handling and operations must be engaged. The consortium consisting of SNC, Candu Energy, AECL and OPG offer such experience.

Project Examples of Application and Readiness

See any petroleum refinery – loading and storage tanks

Challenges

The challenge is to secure suitable tank fabrication capacity and large transporters to deliver to site pre-assembled tanks. The most effective means would be complete assembly of tanks delivered by barges to and roll on rail of dock which may have to be constructed.

Ensure environmental compliance

Intellectual Property/Patent Aspects

No specific patent issues