

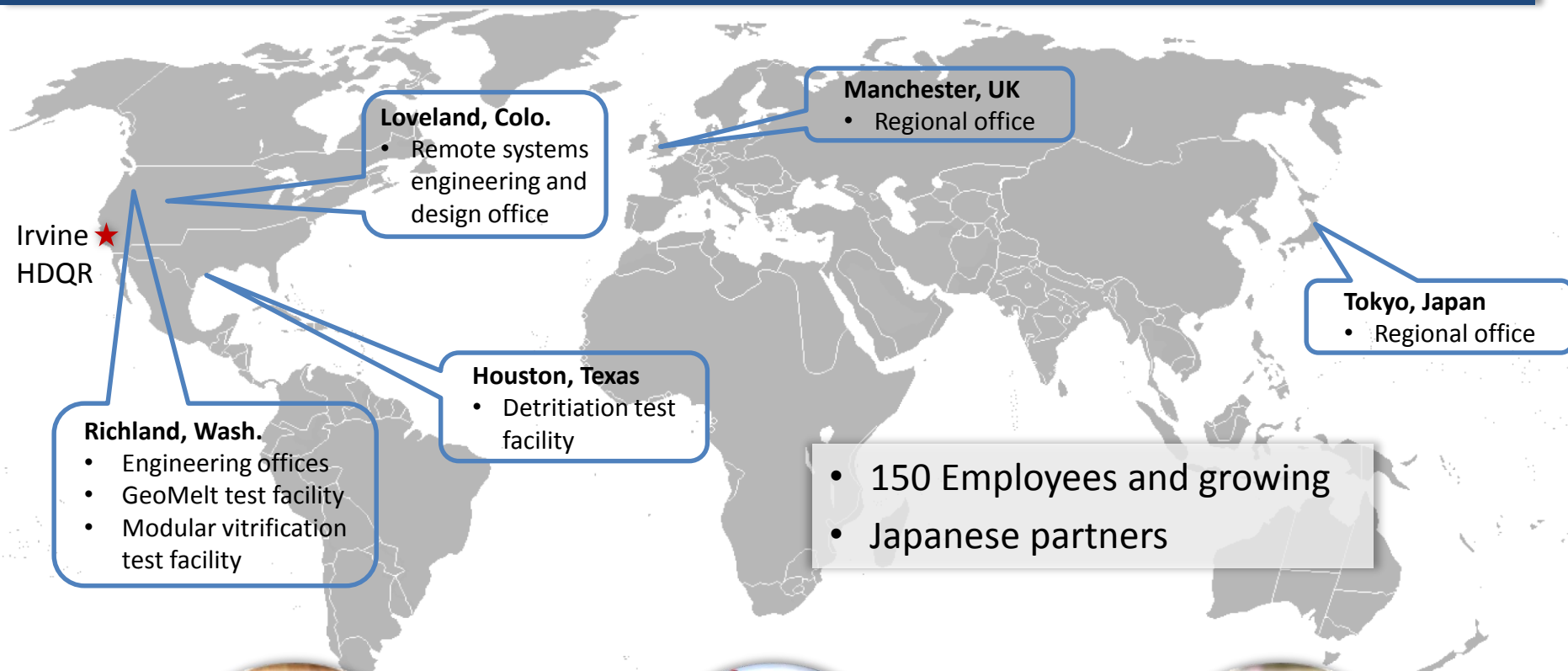
# KURION

## Moving the Needle in Cleaning up Fukushima Daiichi NPP

John Raymont, Founder



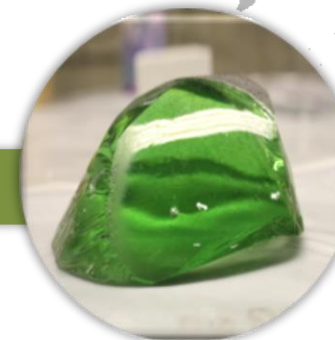
# Kurion Key Facts



Access

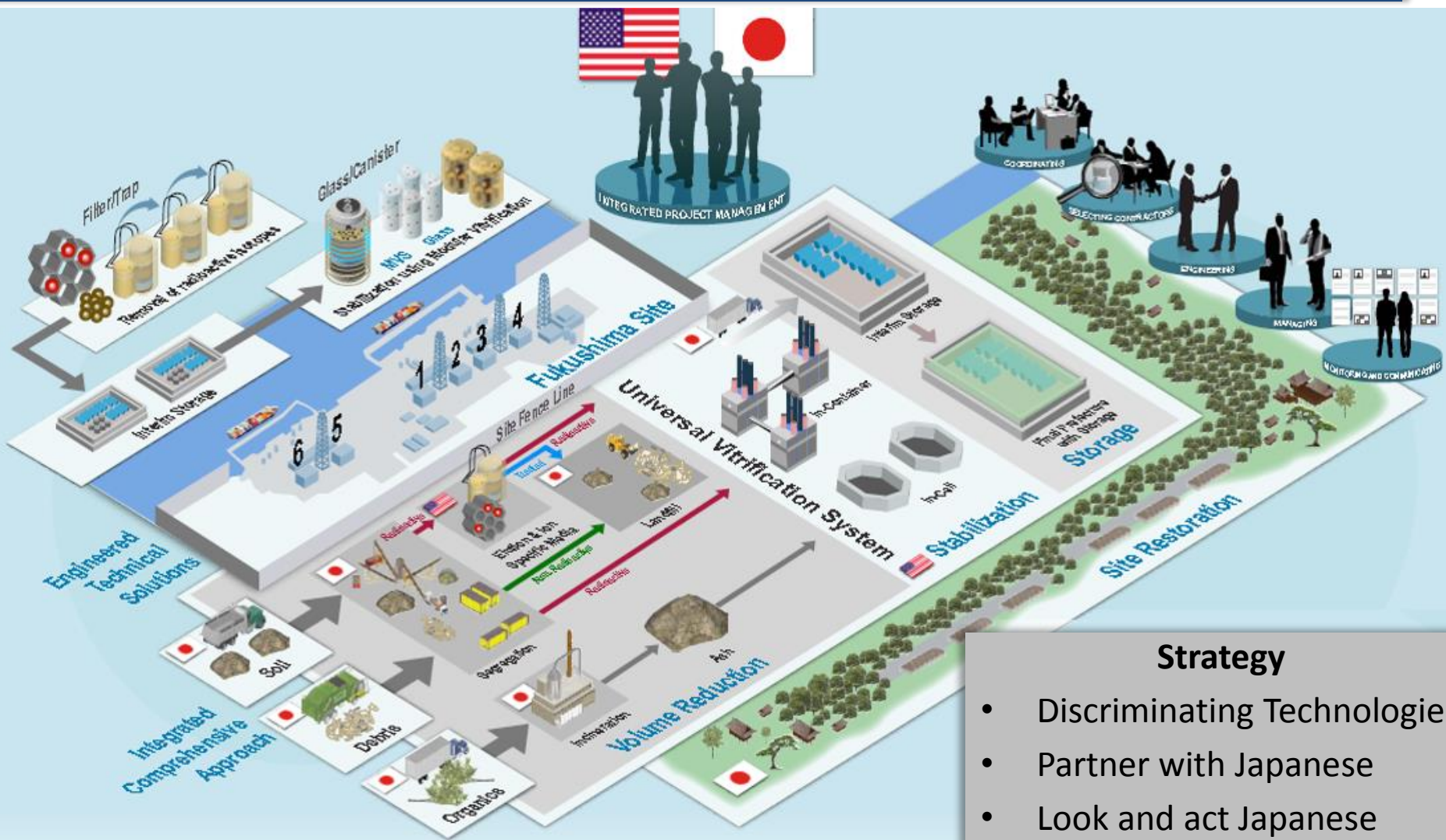


Separate



Stabilize

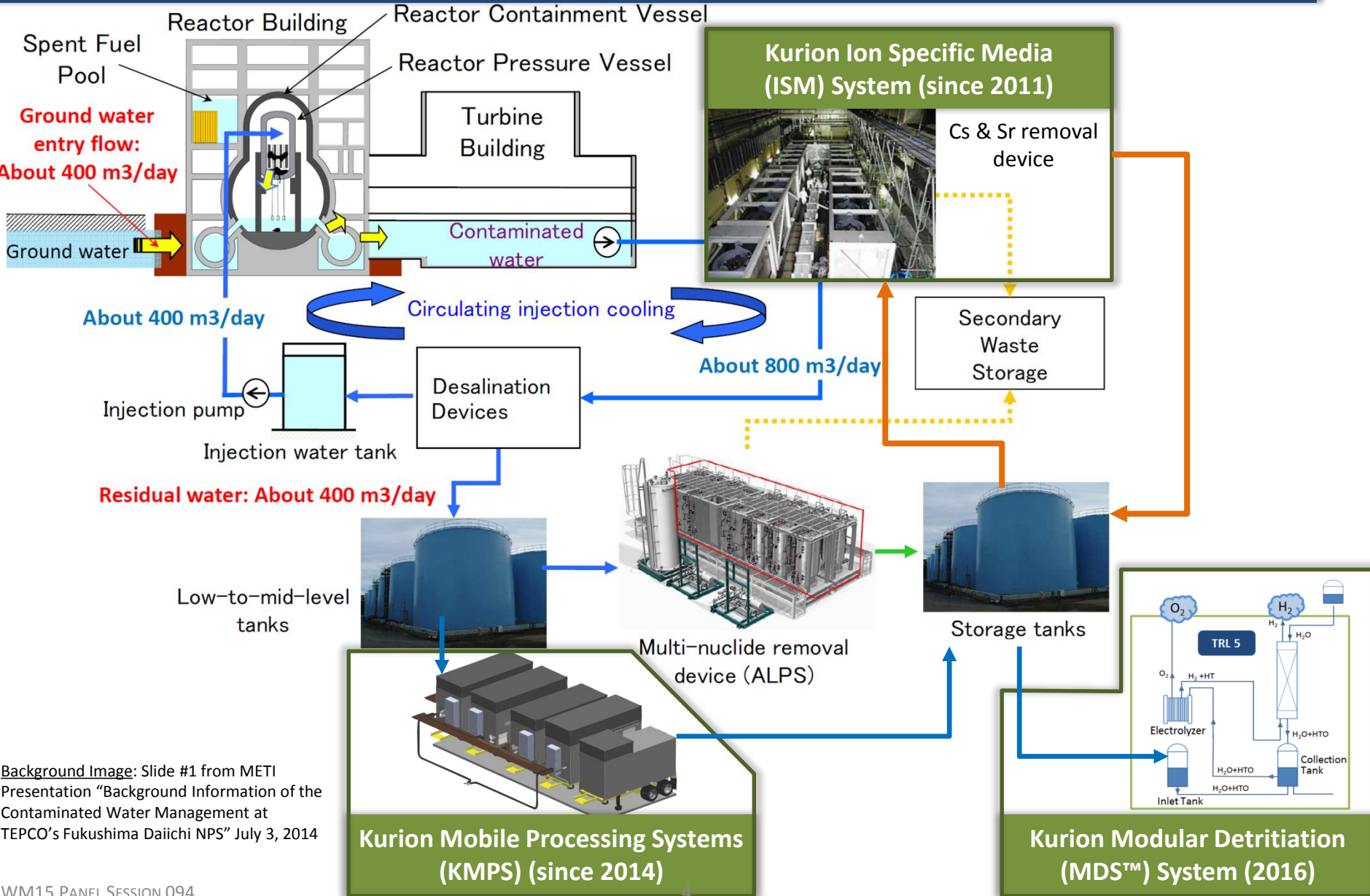
# Japan Strategy – Delivering Technologies



## Strategy

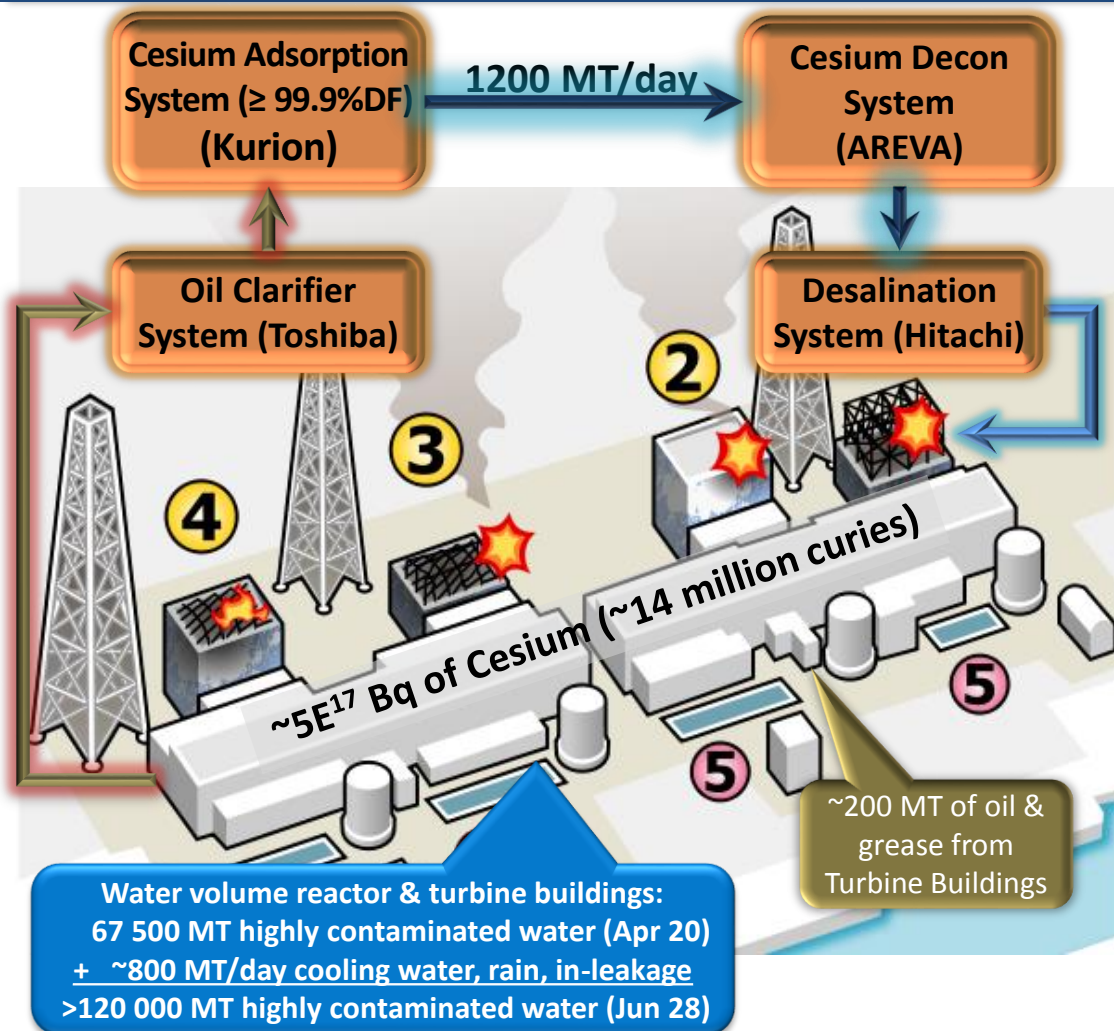
- Discriminating Technologies
- Partner with Japanese
- Look and act Japanese
- Help rebuild public trust

# Liquid Waste Systems Update



**Background Image:** Slide #1 from METI Presentation "Background Information of the Contaminated Water Management at TEPCO's Fukushima Daiichi NPS" July 3, 2014

# Early Responder after 3/11 Accident



### Post Tsunami Challenges:

- Cs-contaminated, saline, oily water & huge volumes
- Near continuous aftershocks to > Magnitude 7
- Summer Rainy Season adds water volume
- Many unknowns about site conditions
- Protestors, police, camera crews on streets
- **Water forecasted to overflow buildings end-June**

## Unprecedented External Reactor Water Cooling System in 8-Weeks

# Result: Reactor Shutdown Ahead of Schedule



tech talk

BLOGS // TECH TALK

## TEPCO Begins Decontaminating Radioactive Water

POSTED BY: JOHN BOYD / TUE, JUNE 28, 2011

Email Print Share



## Kurion Cesium Removal System

Photo: Workers at Fukushima Dai-ichi's water processing facility



*Editor's Note: John Boyd is an IEEE Spectrum contributor reporting from Kawasaki, Japan. This is part of IEEE Spectrum's ongoing coverage of Japan's earthquake and nuclear emergency. For more details on how Fukushima Dai-ichi's nuclear reactors work and what has gone wrong so far, see our explainer and our timeline.*

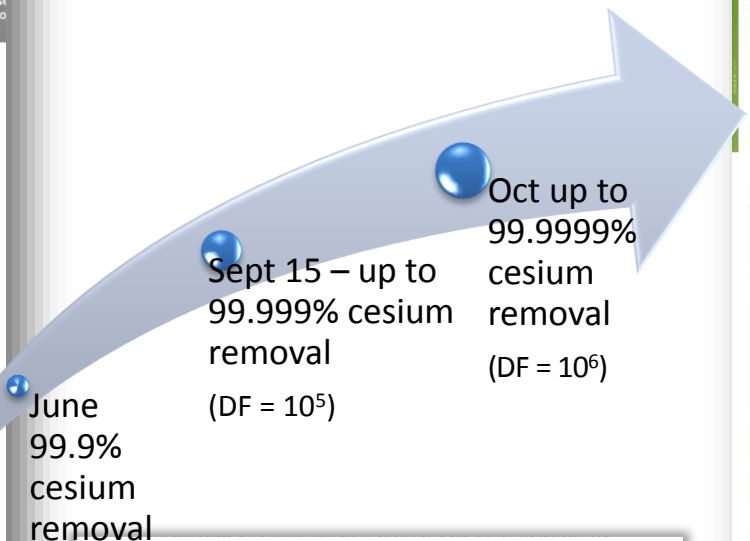
### Coping With Radioactive Water

After a number of frustrating setbacks in testing out the water decontamination system, Tokyo Electric Power Co. (TEPCO) began a series of test runs Monday morning, having treated over 6,000 tons of radioactive water stored in the waste water tanks at Fukushima Dai-ichi. The test runs will involve the release of the system, aiming to use the resulting purified water to cool the damaged reactor Units 1,

**Mid-June 2011**

**Cesium levels 4.2E<sup>6</sup> Bq/cc**

Improved operations and reduced salinity raised Decontamination Factor



June  
99.9% cesium removal  
(DF = 10<sup>3</sup>)

Sept 15 – up to 99.999% cesium removal  
(DF = 10<sup>5</sup>)

Oct up to 99.9999% cesium removal  
(DF = 10<sup>6</sup>)

Contact: Gordon Benhaim  
Phone: +1 (949) 398-4330  
Fax: +1 (949) 462-7028  
Email: gbenhaim@kurion.com

2540 Main Street, Suite 800  
Irvine, CA 92614-4829  
+1 (949) 398-4330  
www.kurion.com

**KURION**  
Isolating Waste from the Environment

### Press Release

#### Kurion Announces Fukushima Daiichi Nuclear Plant Contaminated Water Cesium Levels Reduced by More than 40% System Achieving Performance Goals for Throughput and Cesium Removal

Irvine, CA—August 16, 2011—Tokyo Electric Power Co. (TEPCO) announced today that the Kurion cesium removal system at the Fukushima Daiichi Nuclear Plant had dropped by more than 40% since startup of the Kurion system (see [June 17](#)). As a member of the site's unprecedented effort to maximize decontamination facility (see Cesium Adsorption Instruments), the design of the Kurion 20 MT/hour (220 gpm) rated system is to remove approximately 99.9999% of radioactivity in the contaminated water. In fact, when originally operated in its design configuration the system was removing cesium by a factor of 70,000 (99.9999% removal).

The reliability, safety, and robustness of the Kurion system was recently confirmed by a 16<sup>th</sup> analysis of Water Treatment Facility operations that identified several operational missteps regarding incorrect valve settings and data build-up at the first distillation tank.

**By mid-Aug Cesium Levels Reduced 40% to 2.4E<sup>6</sup> Bq/cc**



ENERGY / NUCLEAR

NEWS

## Shutdown of Fukushima Reactors Is Ahead of Schedule

Success in cooling the reactors suggests the plant could be stabilized by year's end

By JOHN BOYD / NOVEMBER 2011

Email Print Share



Photo: TEPCO

DOUBLE CHECKED: Workers at Fukushima Dai-ichi reactor 1 check a water level indicator. Injected water has cooled the cores, but it has also created contamination at the site.



*Editor's Note: This is part of the IEEE Spectrum special report: Fukushima and the Future of Nuclear Power.*

This past April, when the Japanese government and Tokyo Electric Power Co. (TEPCO) jointly unveiled their plan to bring the damaged reactors of the Fukushima Dai-ichi nuclear power plant to a controlled shutdown and gain control of the release of radioactive materials, the goal was to reduce cesium levels to 20,000 Bq/cc.

**Nov 2011**  
**Cesium Levels Reduced 70% to 1.3E<sup>6</sup> Bq/cc**

# ISM System Today (formerly Cs Adsorption System)

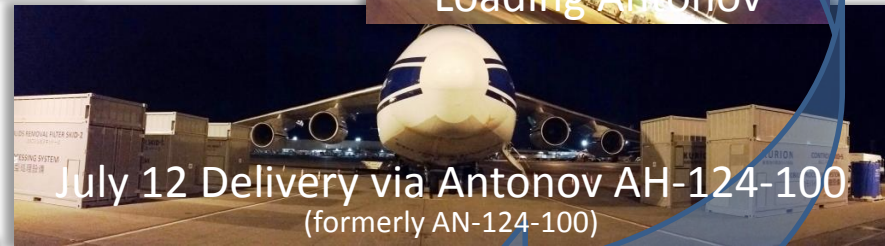
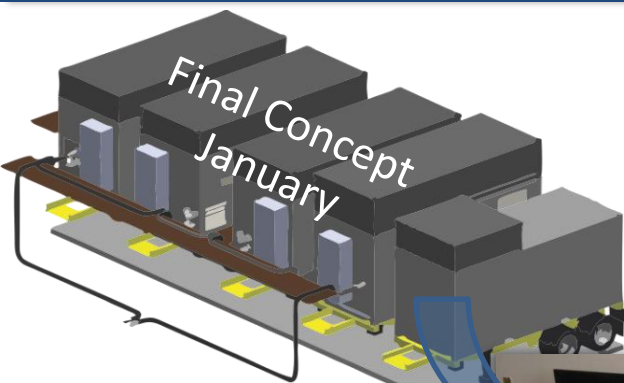


Kurion Project Manager Inspects System

- High reliability is its trademark
  - No single point of failure, no leakage no tripping balance of system
  - Responsible for removing ~70% of all cesium activity to date (source: [IRID](#))
  - >270,000 m<sup>3</sup> (72M gals) processed (source: [TEPCO](#))
- Upgrades completed end-2014
  - Installed sampling system
  - Option of dual isotope removal or very high DF single isotope (two double length process trains) or original high volume (four single length process trains)
- Dual isotope removal mode initiated Dec; very good DFs for both Cs and Sr removal
  - Cs DF – to 1E<sup>5</sup> (routinely achieving MDA)
  - Sr DF – approximately 3.5E<sup>3</sup>
  - Many other Isotopes reduced to MDA or near MDA
- Processing trench, Turbine Building, and PMB basement water

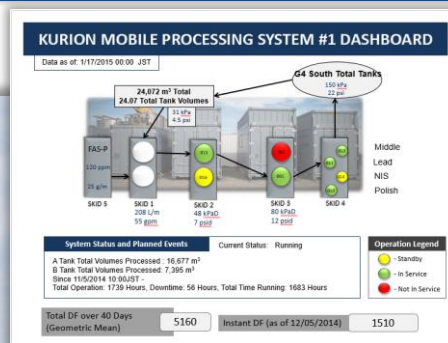
Continuous operation mode with dual isotope Cs/Sr removal

# Delivery: KMPS-1 in 7-Months; KMPS-2 in 13-weeks





# Kurion Mobile Processing Systems for Tank Water



KMPS-1 Operating Since Oct



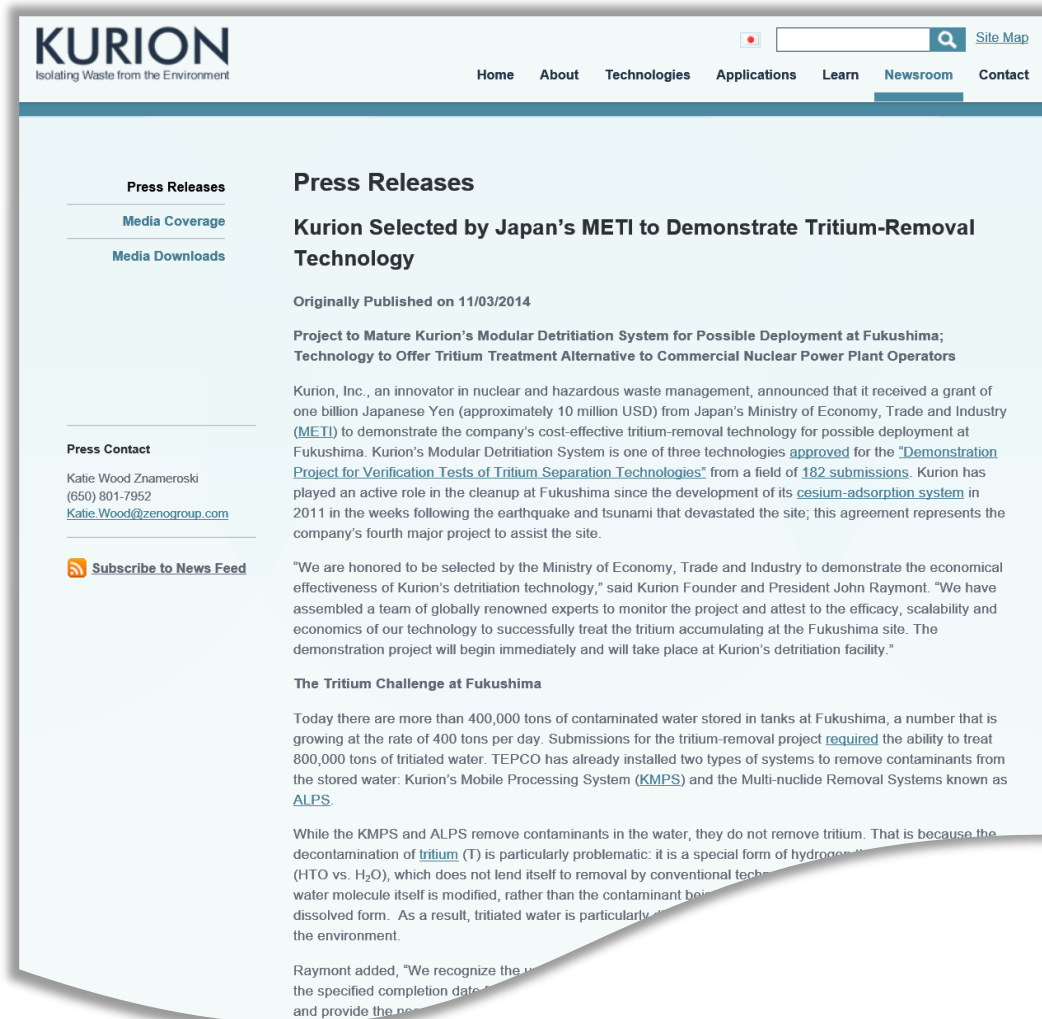
KMPS-2 Operating Since Feb 10

- 1<sup>st</sup> of a kind at-tank isotope removal system
- Sr reduction goal to support PM Abe's commitment for site safety improvement
- TEPCO evaluating next missions for Systems

Satisfied Rigorous JNRA Requirements, > 90% TOE and Exceeding Contracted DF Goals

# Modular Detritiation System (MDS™)

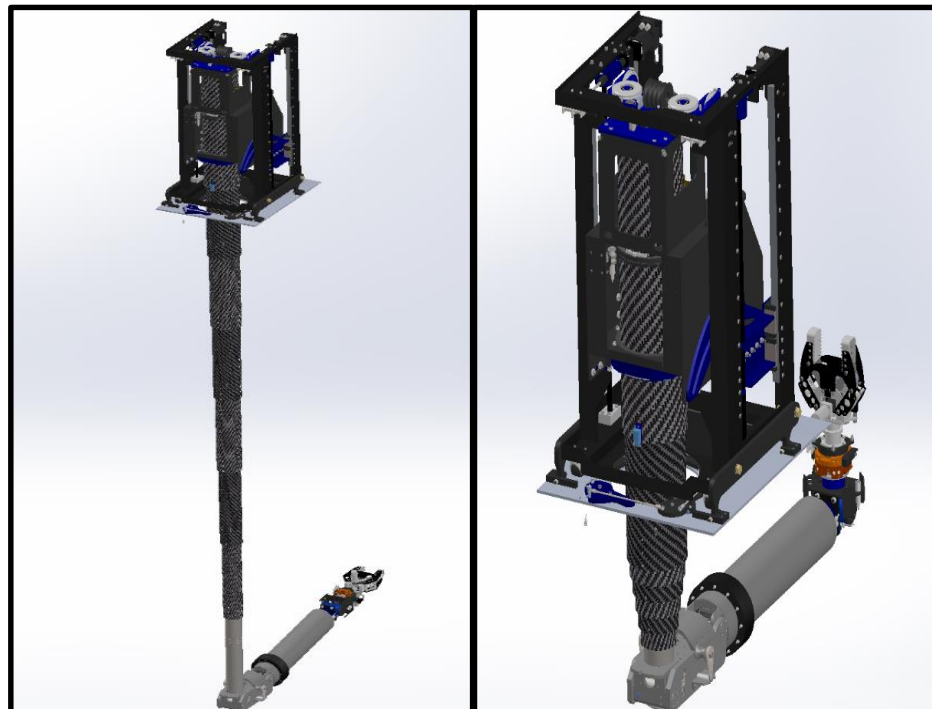
- ALPS can only process 62 of the 63 isotopes, leaving tritium untouched
- ¥1B METI demonstration grant:
  - Won over 182 applicants
  - Alternative to release 800,000 m<sup>3</sup> water at 40X annual activity release limit of 1F
  - Process inlet water of low tritium activity ( $1 \times 10^6$  to  $5 \times 10^6$  Bq/l) to achieve effluent of  $\leq 6 \times 10^4$  Bq/l
  - Economical processing
  - TRA approach using external reviewers (e.g. SRNL, METI, SMEs)
  - Demonstration ends March 2016
- Full scale award expected 2<sup>nd</sup> quarter 2016 with nominal 8-year duration



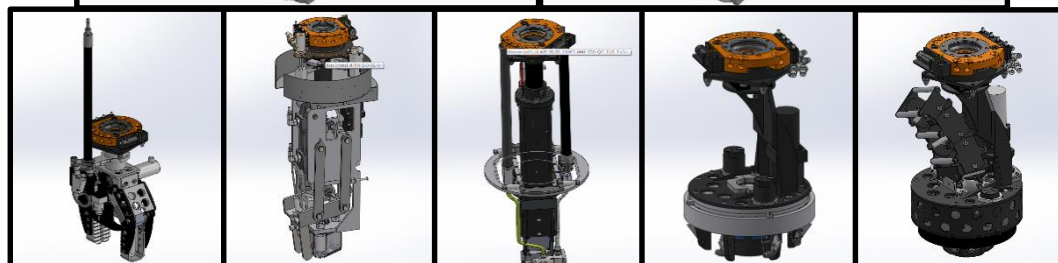
Help Rebuild Public Trust in Institutions

# Fukushima Repair Manipulator (FRM)

- Detail Design of FRM completion March
- Component Testing for FRM Tools scheduled for March through April
  - Waterjet Tools (Type 1,2,3) – used to cut access holes and create penetrations for Grout and Inflatable Bag Tools
  - Grout Tool and Inflatable Bag – used to plug vent tubes (picture below)
- System deployment 2016



*Access location in vent tube for Inflatable Bag Tool and Grout Tool*



*Left to Right: Waterjet Tools (Type 1,2,3), Inflatable Bag Tool, Grout Tool*

Follows Success of the Kurion Fukushima Inspection Manipulator in 2014

# 1F Fuel Debris Removal Project

- IRID award Fall 2014
- Kurion Conceptual Design and Report complete
- Final report/presentation to IRID end-March
- Six month hold period for decision on Dry versus Wet approach (by late summer)
- Fuel Debris Removal operations start expected 2020

Hoist Platform Concept

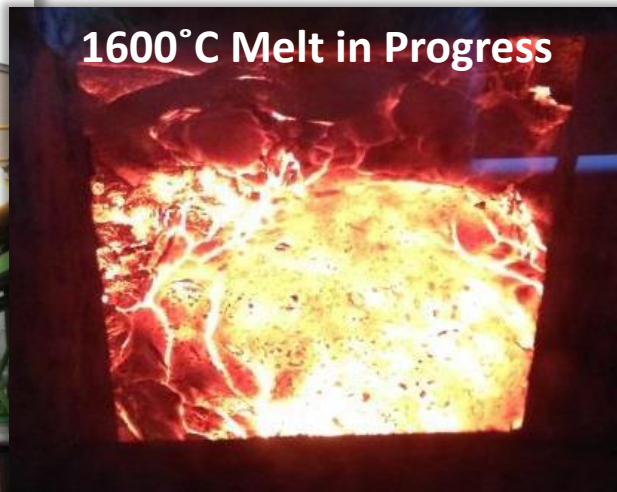


# GeoMelt® Vitrification Mie Prefecture

Production 9.5 MTG Melters

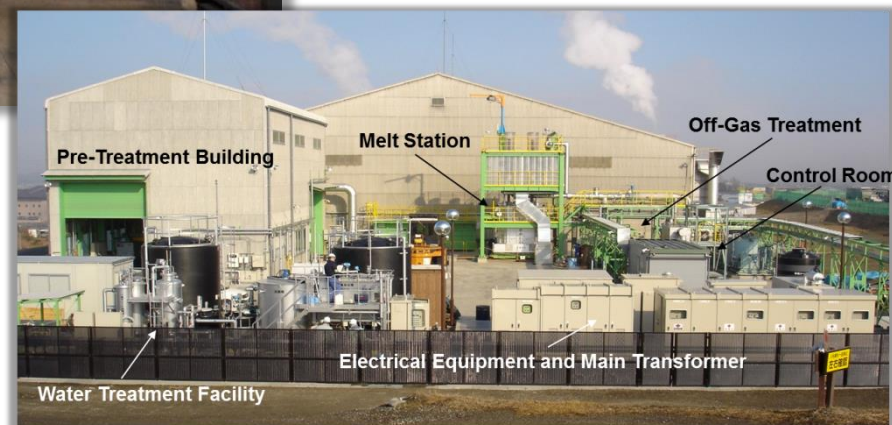


1600°C Melt in Progress



Melter in Preparation

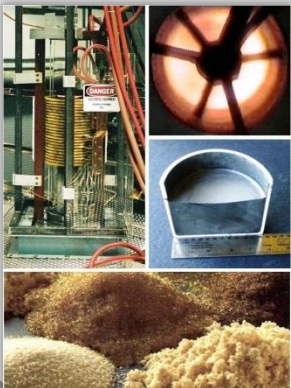
- **ISV Japan Ltd.** – Licensee since 1995
- **Daiei Kankyo** – Site operator, largest municipal waste management company in Japan and shareholder of ISV together with Kurion
- **Iga City Facility** – since 2003 for hazardous wastes plus various engineering scale systems for demos



- Pre-Treatment Building
- Melt Station
- Off-Gas Treatment
- Control Room
- Water Treatment Facility
- Electrical Equipment and Main Transformer

# Discriminating Waste Separation and Stabilization Solutions

Sales of Demos, Studies, & Concepts



Design of Solutions and Systems



Fabrication of Systems and Equipment



Proprietary Ion Specific Media (ISM)



Supply of Proprietary Waste Canisters



*Working with Partners  
To Deliver Success*

**Kurion Works with Partners to Isolate Waste from the Environment**



# WHY FUKUSHIMA SUCCESS IS IMPORTANT

# Significance of Fukushima

- D&D requires many first-of-a-kind solutions due to
  - Plant explosions
  - Reactor meltdowns
  - Torn primary containments
  - Cracked foundations
  - Groundwater
  - Scale of the challenges
  - Complexity covers elements found at nuclear plants and weapons complex
- Societal impacts
  - Influence on stakeholder trust (e.g. public, regulator)
  - Influence on nuclear industry
  - Political impacts both in and ex-country



# Recent Articles: 1F Cleanup Costs & Weakened Yen



## Fukushima Dai-ichi – Mission impossible *An industrial clean-up without precedent*

Feb 7th 2015 | FUKUSHIMA | [From the print edition](#)

THE stricken Fukushima Dai-ichi nuclear plant is the **world’s most complex and costly industrial clean-up**. The first three of Fukushima Dai-ichi’s six reactors melted down in March 2011 and the fourth was damaged. **TEPCO’s early guess was that decommissioning would take 30-40 years. That is certainly optimistic....**

Solutions create new problems. Water is pumped in to keep melted uranium at the bottom of reactors one, two and three from overheating. A purification system, known on-site as the “seven samurai”, is struggling to keep up with the flow of contaminated water being produced—370,000 tonnes and rising is stored in vast tanks. **Even when the worst nuclides are filtered out, TEPCO will face huge opposition with plans to dump the water into the Pacific...**

**TEPCO says decommissioning Dai-ichi’s four damaged reactors will cost ¥980 billion, but that does not include the clean-up, fuel storage or compensation. On a broader reckoning, the Japan Centre for Economic Research, a private research institute, puts the bill over the next decade at ¥5.7 trillion-¥20 trillion, but that still excludes compensation to the fisheries and farming industries. A still broader calculation by the same institute puts the entire cost of the disaster at ¥40 trillion-¥50 trillion. Thanks to government bail-outs, the company that so mismanaged Fukushima Dai-ichi carries on. It even says it will make a profit this year.**

## THE WALL STREET JOURNAL

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<http://www.wsj.com/articles/weak-yen-rekindles-hope-for-made-in-japan-1421618401>

ASIAN BUSINESS NEWS

## Weak Yen Rekindles Hope for ‘Made in Japan’

Electronics Makers Among the Vanguard of Those Bringing Production Back Home



“One dollar today buys about ¥117.4, compared with about ¥80 in mid-2012”

Daikin Industries, a maker of air conditioners, has already shifted some output to Japan from China and might do more this year, the company’s chairman said. PHOTO: SHIZUO KAMBAYASHI/ASSOCIATED PRESS

By ERIC PFANNER  
Jan. 18, 2015 5:00 p.m. ET

TOKYO—Japanese business leaders once again are touting “made in Japan” labels, promising to return production from overseas to take advantage of the yen’s sharp drop, which has reduced the once sky-high cost of manufacturing here.

## TEPCO Seeking Lowest Lifecycle Cost Solutions