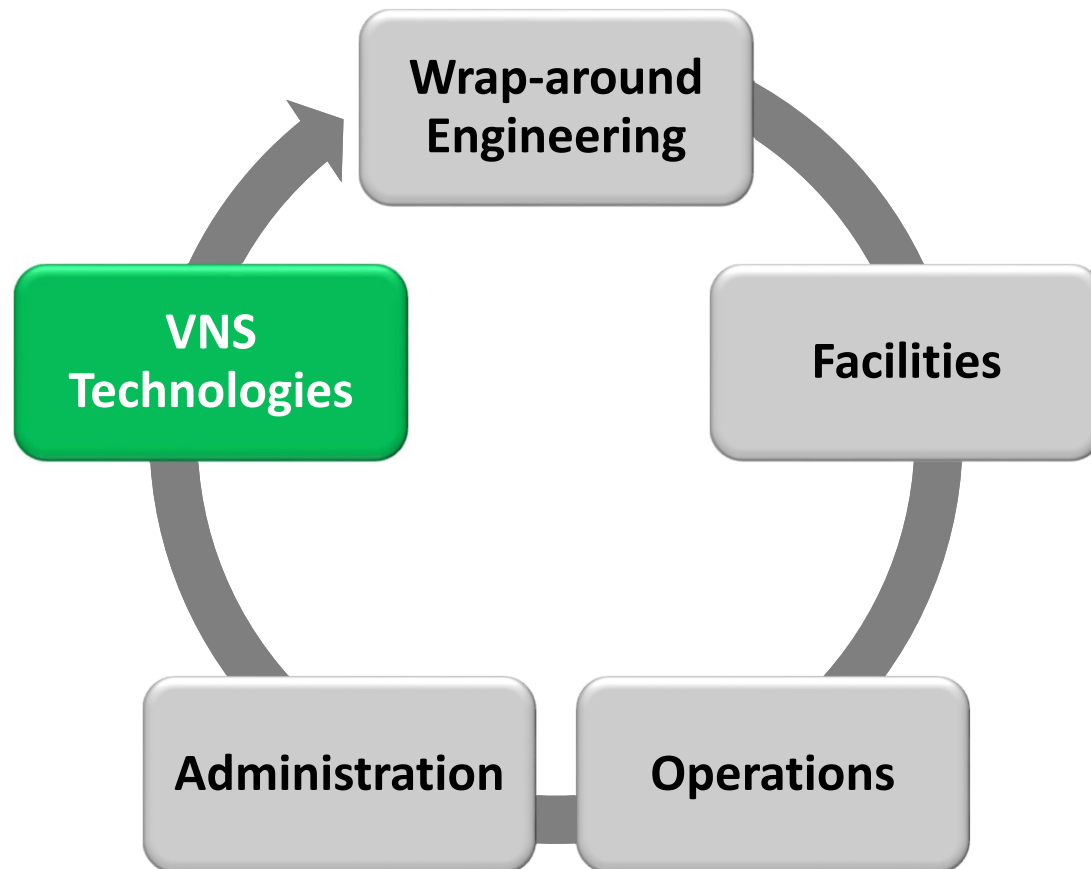


**Veolia Nuclear Solutions Technologies**  
*3/11 Response, Today and the Future*  
*John Raymont*

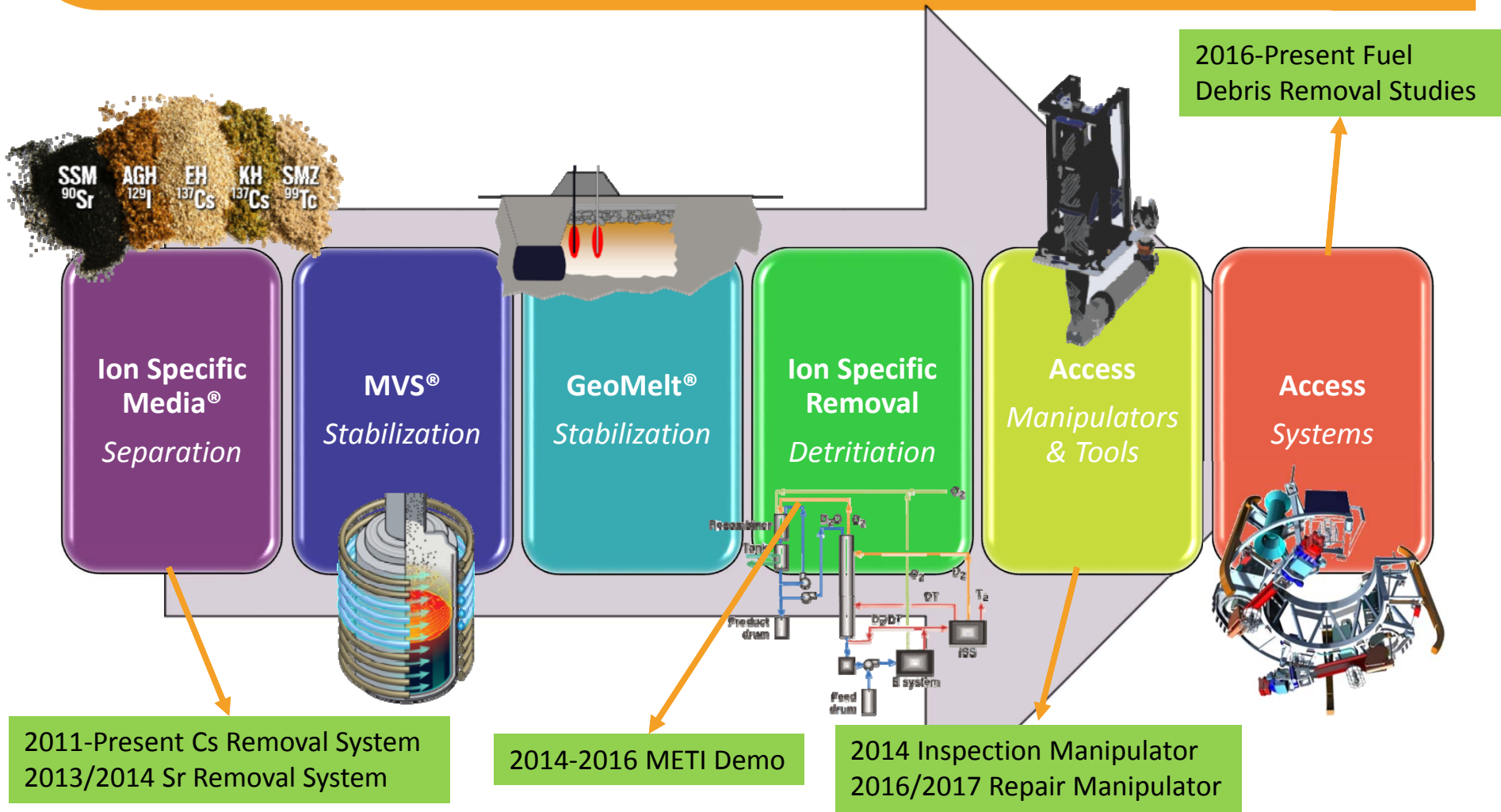


**NUCLEAR SOLUTIONS**

# Working with Partners to Deliver Success, Safely



# Delivering Technologies That Work Together



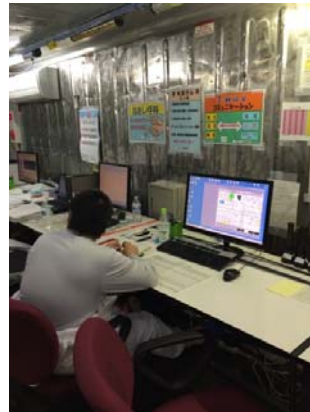
Expanding Set of Discriminating Technologies via Development and Acquisition

# Three Isotope Removal Systems

Kurion Ion Specific Media System (ISMS): skid-mounted modular assemblies to treat reactor water at 1200 m<sup>3</sup>/day, removed ~70% of all Cs – since June 2011



Kurion Mobile Processing System (KMPS): 5 skid-mounted assemblies used for at-tank mobile isotope removal to treat radioactive water stored in hundreds of water storage tanks on-site at Fukushima. The system in this case is primarily used to remove Sr from the water with a process rating of 300 m<sup>3</sup>/day – since Oct 2014



ISMS

KMPS-1

KMPS-2

# First-of-a-Kind External Reactor Cooling System

## Real Time Balancing Goals w/Site Limitations/Unknowns



Conversion of Tool Shop to High Rad Work Area



Work Area Limitations Drive Vessels

### Site Conditions

- Urgency to implement
- Multiple unknowns
- Tight working conditions
- Overhead crane limitations
- Floor loading limitations
- Lack of facility shielding
- Coordination under high stress

### Media/System Capabilities

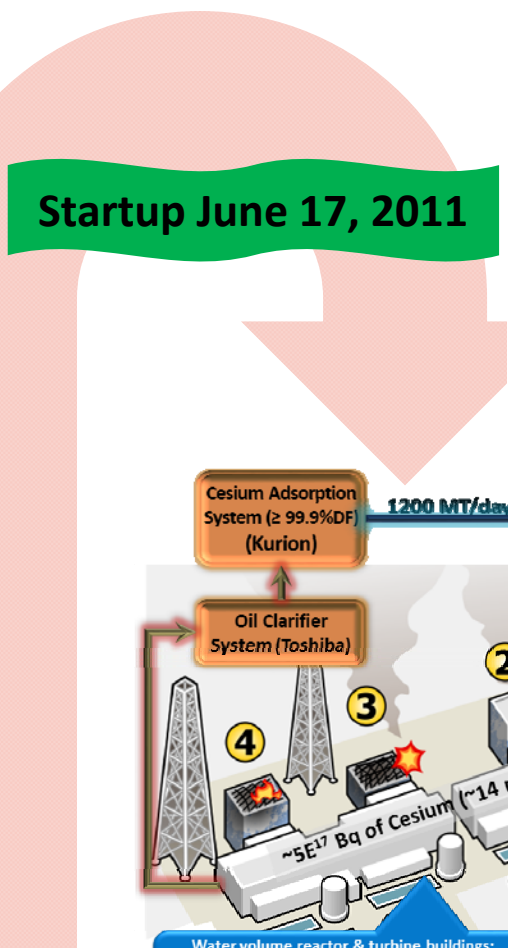
- Redundancy to offset lack of timely nuclear grade components
- Plug-n-Play to speed installation
- Lack of full remote operation
- System Removal Capabilities
- Vessel Loading Limits
- Number of Depleted Vessels

Design, Iteration and Fabrication 24/7 for 5 weeks

## System Had To Work Day One and Continue Reliably



Plug-n-Process Modular Skid-Based System Allowed Fast Fabrication and Startup



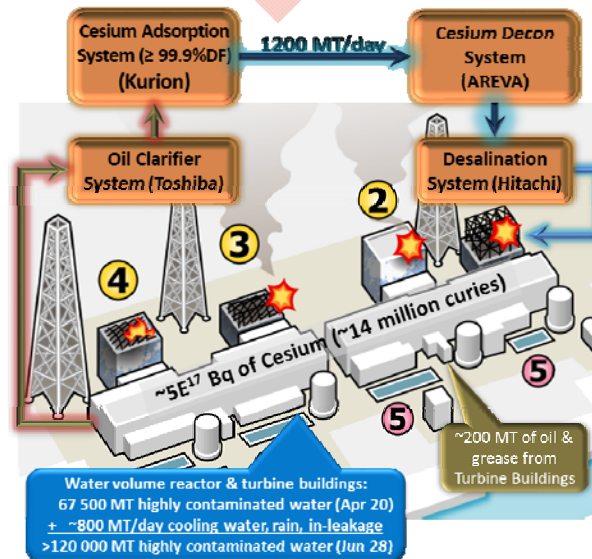
## Cesium Media Testing by the EPRI

- Fall 2010 the EPRI held a competition on live waste at Seabrook NPP comparing a wide range of medias (EPRI Report TR-1021099)
- KUR-EH came out on top of a wide range of cesium removal medias (in fact outlived the test by not reaching breakthrough after more than 3,000 bed volumes)
- Enabled Mar 29, 2011 Press Release on availability of 100 tons of Herschelite media



Radiation Specific Media becomes a standard for Three Mile Island Unit 2, available for Accident Evaluation Nuclear Plant Change

Competition Provided Initial Validation of Kurion Technologies



- ### 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

5 Weeks from Award to System Shipment/8 Weeks from Award to Startup

# ISM System (formerly Cs Adsorption System)



- High reliability is its trademark
  - ◆ No single point of failure, no leakage no tripping balance of system
  - ◆ Responsible for removing  $>3.4E17$  Bq (9.2MCi), or  $\sim 70\%$  of all Cs activity to date
  - ◆  $>300,000$  m<sup>3</sup> ( $>80$ M gals) processed
  - ◆ All wetted surfaces 316L SS
- 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 Cs and Sr removal
  - ◆ Cs DF – to  $1E^5$  (routinely achieving MDA)
  - ◆ Sr DF – approximately  $3.5E^3$
  - ◆ Many other Isotopes reduced to MDA or near MDA

Continuous Operation Mode with Dual Isotope Cs/Sr Removal

# First-of-a-Kind At-Tank Mobile Isotope Removal

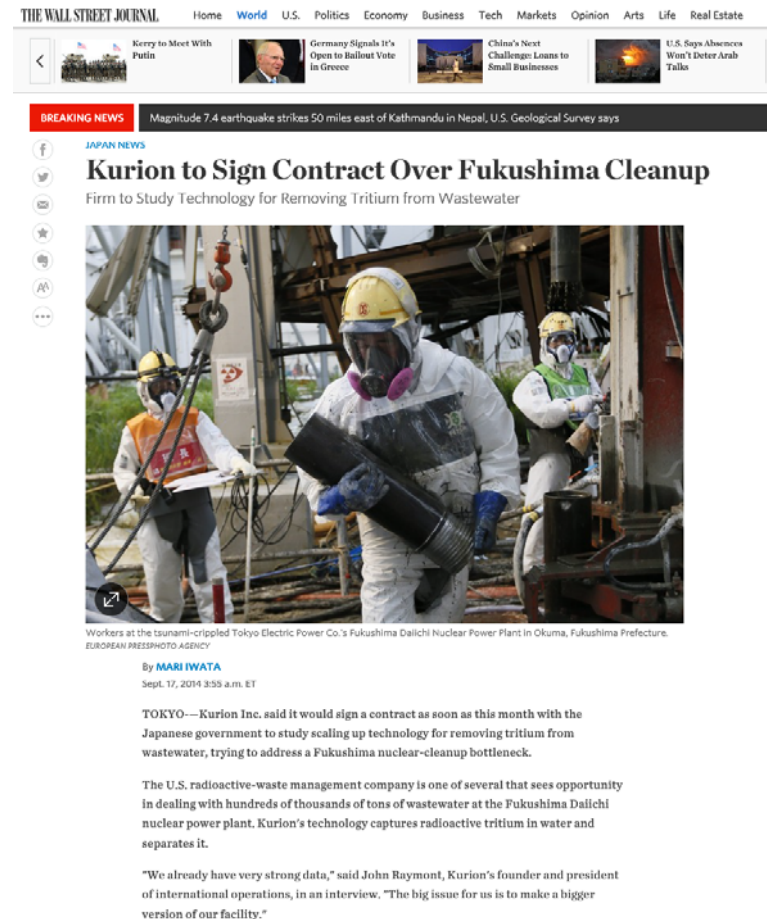


- 1<sup>st</sup> of a kind isotope removal system
- Sr reduction goal to support PM Abe's commitment for site safety improvement

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

# Modular Detritiation System (MDS™)

- ¥1B grant by Japanese government to demonstrate tritium removal:
  - ◆ 182 RFI applicants
  - ◆ Viable and economical processing of tritium
- Alternative to release of 800,000 m<sup>3</sup> (210M gals) of tritium contaminated water



Helping to Rebuild Japanese Stakeholder Trust in Institutions



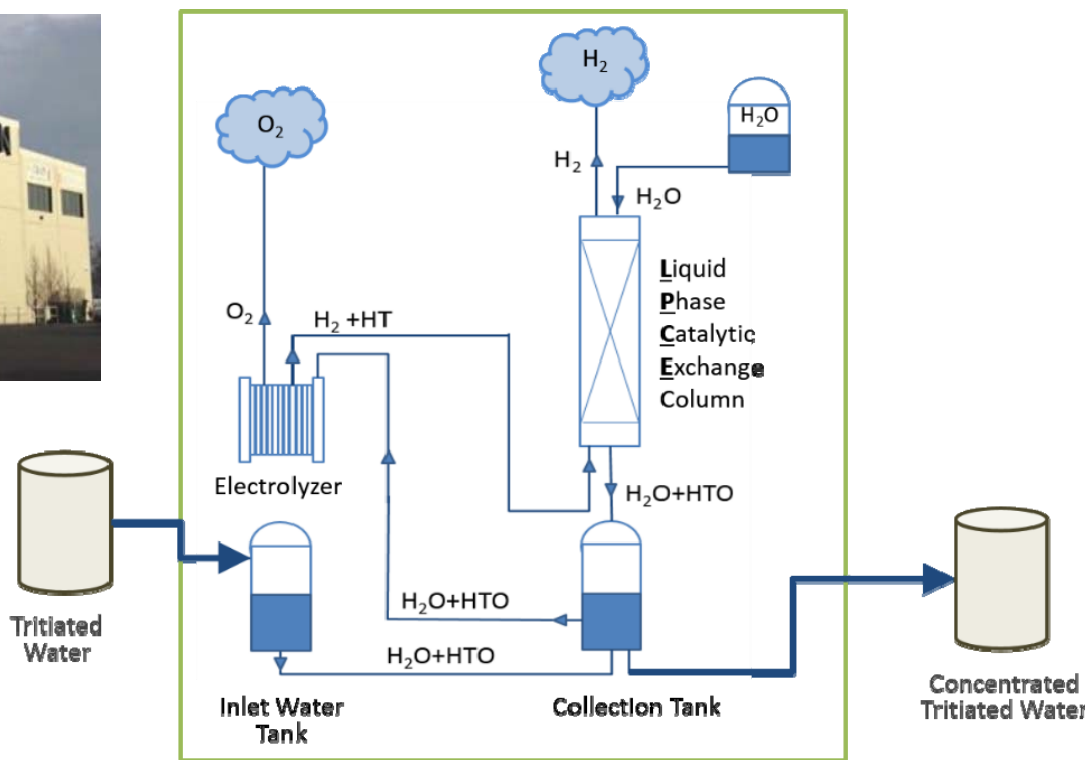
# Modular Detritiation System<sup>®</sup>



Facility Exterior



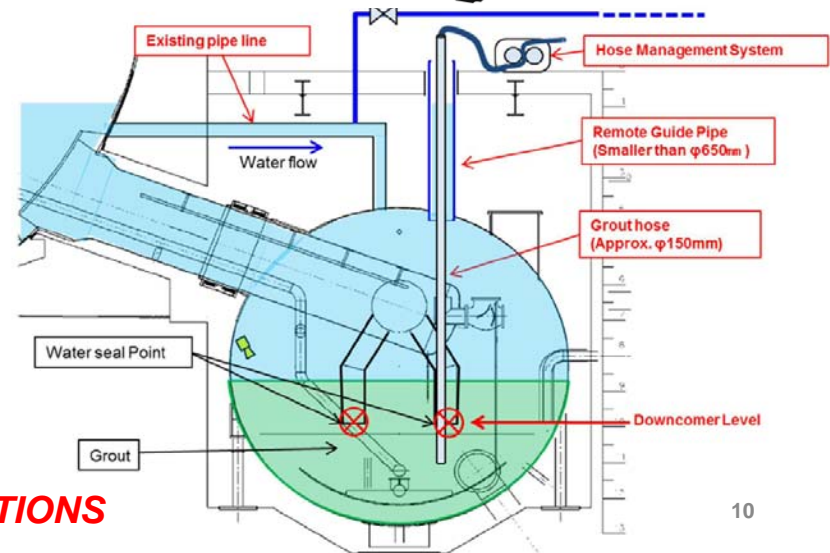
MDS Enclosure Area



Full Scale Prototype MDS<sup>®</sup> Constructed, Commissioned and Completed Hot Startup

# Robotic Systems and Services

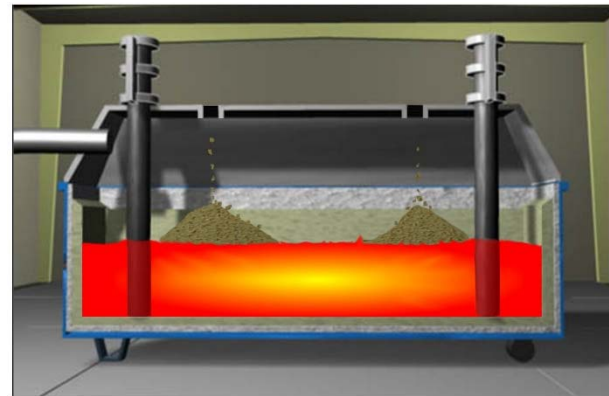
- Supporting various initiatives including reactor inspection, repair and fuel debris removal
- Inspection Manipulator
  - *First system deployed in 2014 to identify leaks with the Unit 2 reactor at Fukushima (see image to right)*
  - *Design basis applicable to future application at Fukushima and wherever access to high hazard environments are constrained, e.g. Hanford Tanks*
- Repair Manipulator
  - *Follow-on to inspection manipulator*
  - *To repair torus leaks*
  - *In Yokohama for operator training and 2017 deployment*
- Performing fuel debris removal studies



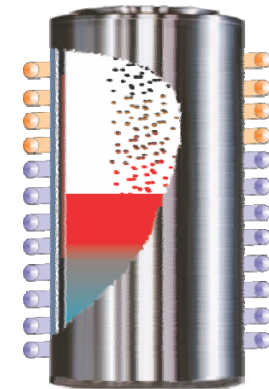
# Waste Vitrification Technologies

## In-Container Vitrification (ICV™) Technologies

- ✓ Modular
- ✓ Single Use Container
- ✓ Wide temperature ranges
- ✓ Wide waste and glass chemistry ranges
- ✓ Processing flexibility
- ✓ Reduced pre-treatment
- ✓ High Volume Reduction
- ✓ Robust
- ✓ Reliable
- ✓ Simple
- ✓ Fast deployment
- ✓ Lower initial and overall lifecycle cost



GeoMelt® ICV™



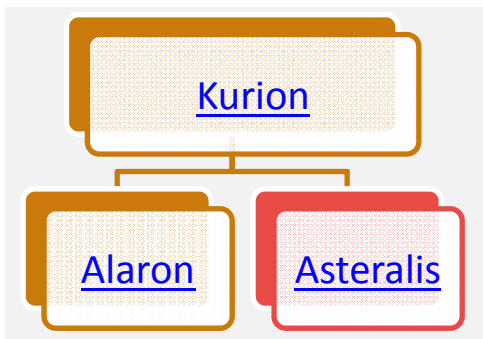
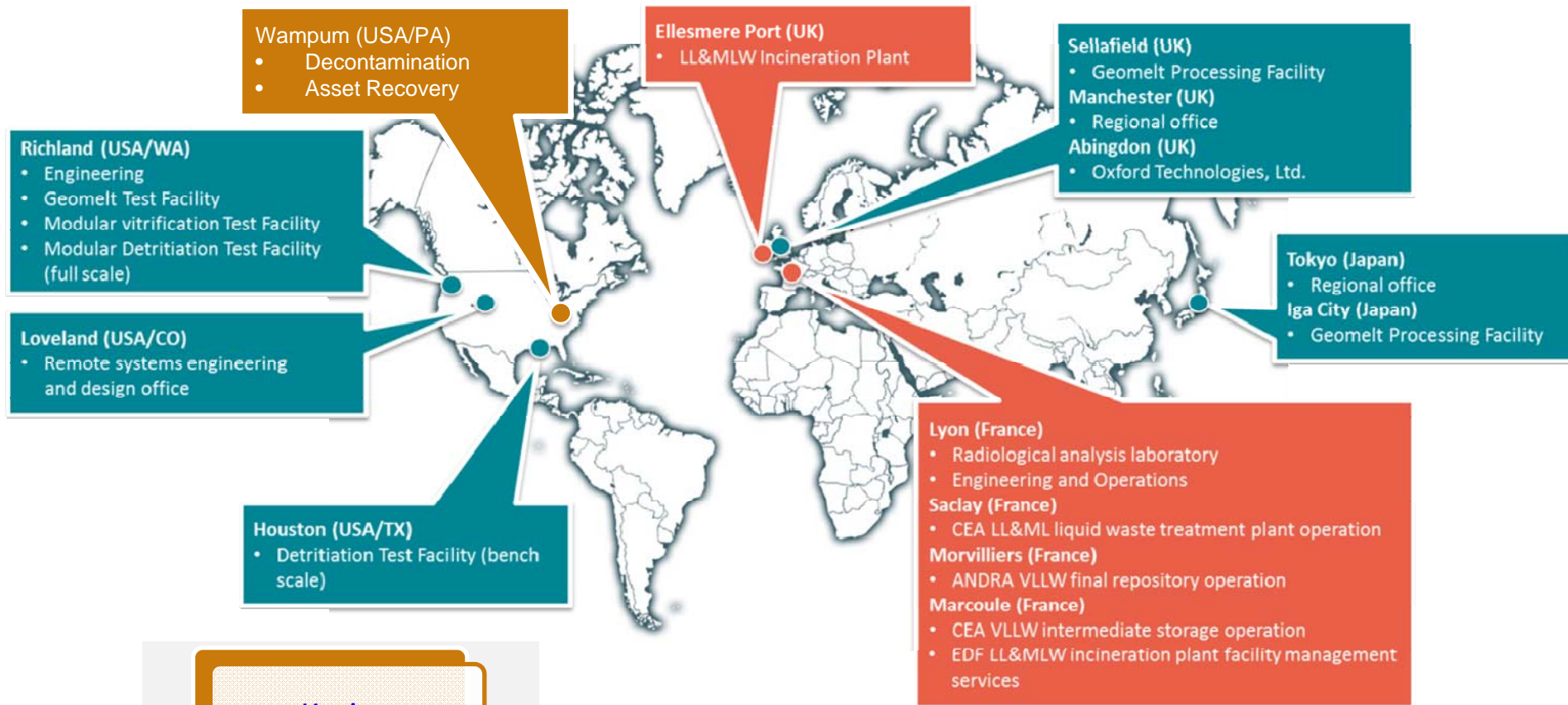
Modular Vit. System (MVS®)



GeoMelt® is installed in NNL UK.

Less Complex and Lowest Lifecycle Cost

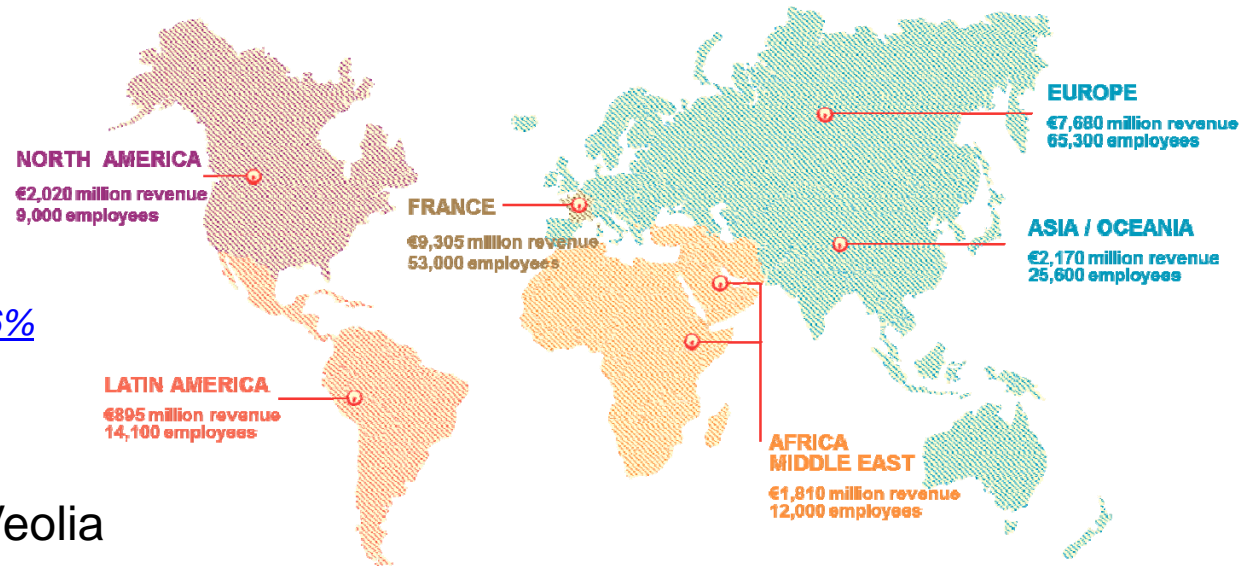
# Where VNS Works Today



€150 Million revenue  300 Employees

# Part of the Veolia Group

- o Three core businesses:
  - o *Water*
  - o *Waste Management*
  - o *Energy Services*
- o Publically traded
  - o *Paris Euronext/CAC40: [VIE](#)*
  - o *France sovereign fund a [8.6%](#) Shareholder*
- o USA Engineering News Record ([ENR](#)) Top 200 Environmental Firms – Veolia North America ranks 4<sup>th</sup>
- o Fortune Global 500 – Veolia ranks [382](#) of world’s largest companies



## Kurion Leads Veolia’s Nuclear Business

# Integrating Veolia's Full Capabilities

