

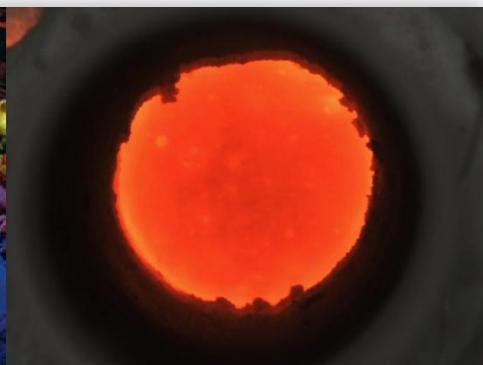
# KURION

## Isolating Nuclear Waste from the Environment

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# Company Overview – Discriminating Technologies

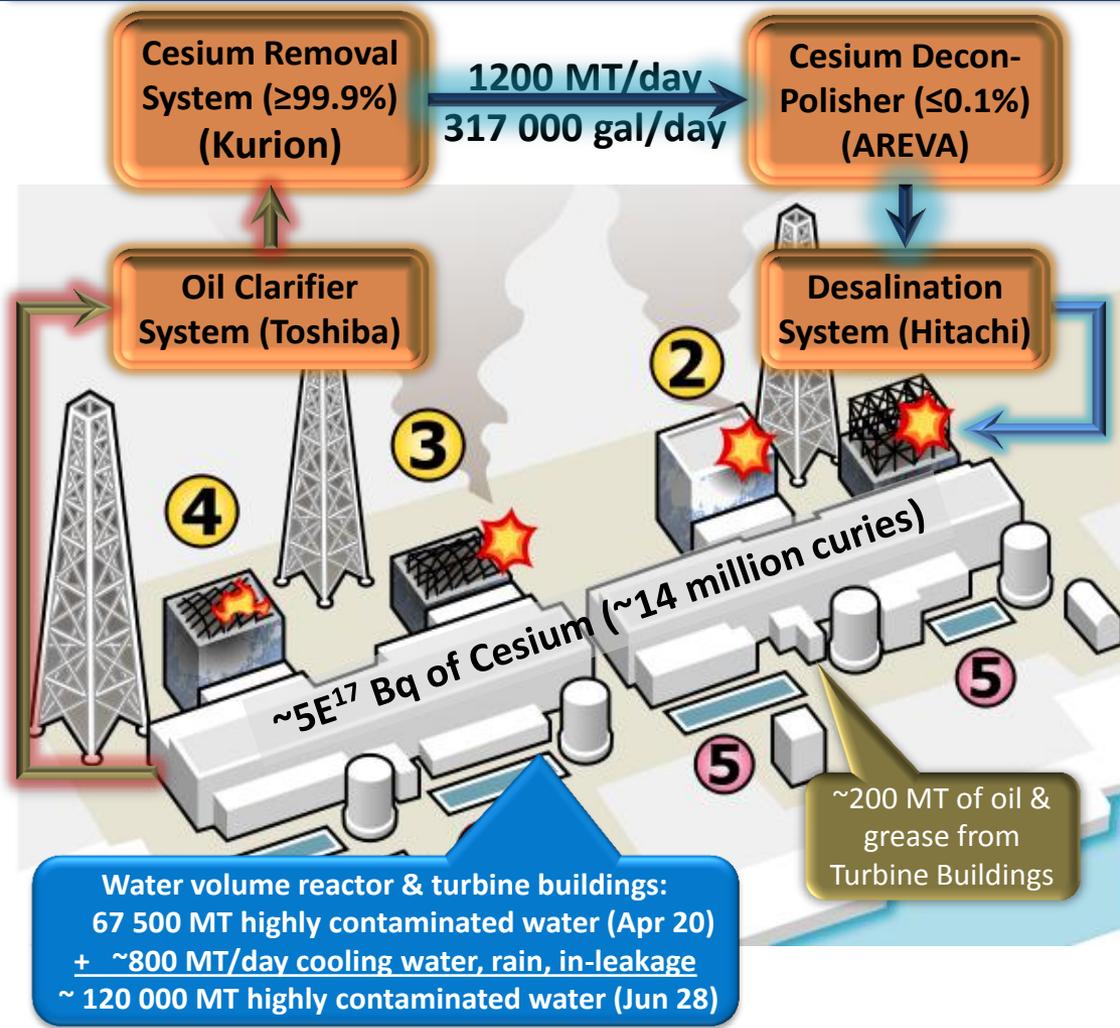
Concept of Operations-Global Solutions

**KURION**  
 Building Hope from the Environment



- Business lines
  - Isotope removal
  - Vitrification
  - Decommissioning technologies
- Offices in Irvine, Richland, Oak Ridge and Tokyo
- ~ 100 Employees
- Partners in Japan and U.S.

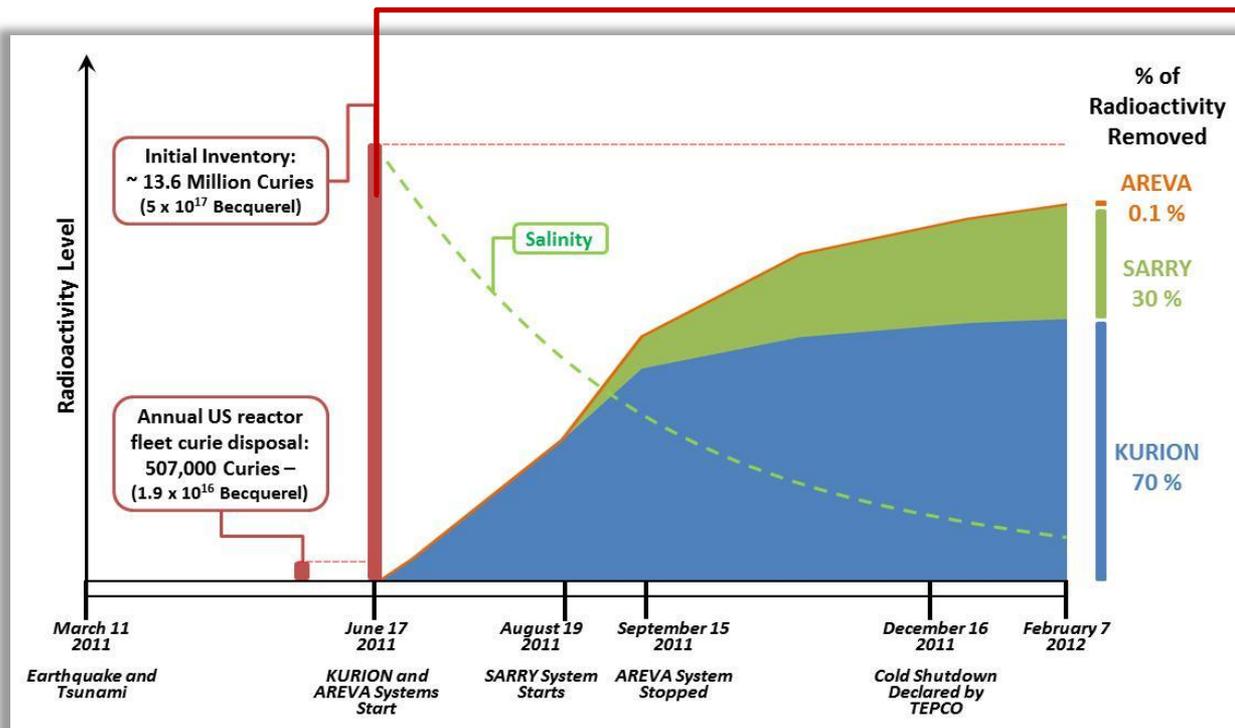
# Early Responder after 311 Accident



- 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 Two Months

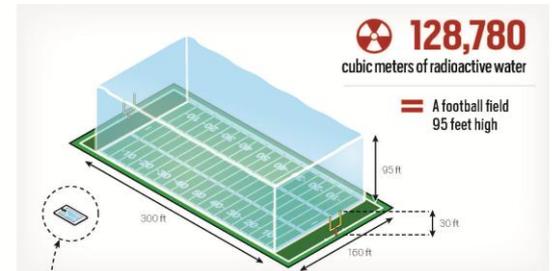
# Timely and Historic Performance



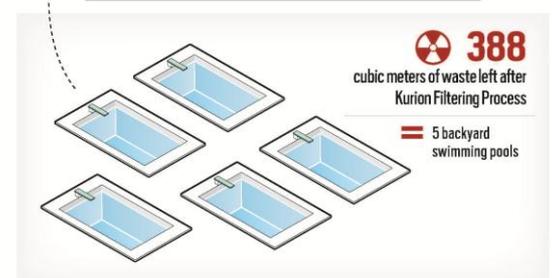
## Kurion Reduces Nuclear Waste at Fukushima

### 1. Radioactive Water Treated by the Kurion System

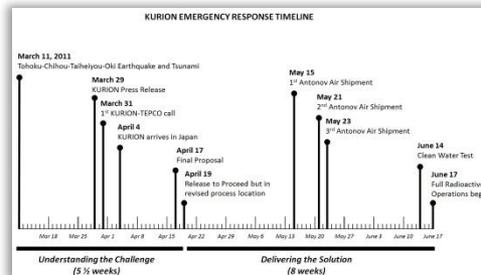
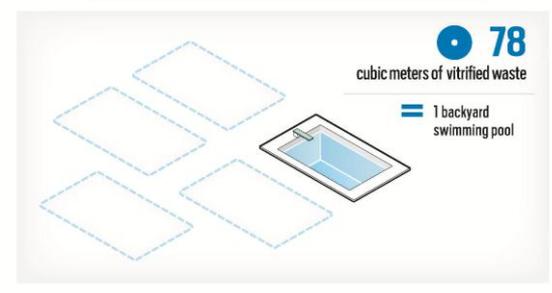
Between June 17, 2011 and February 7, 2012 (235 days)



### 2. Kurion Filtering Process Cuts Volume to 0.30%



### 3. After Vitrification, the Volume Remaining is 0.06%



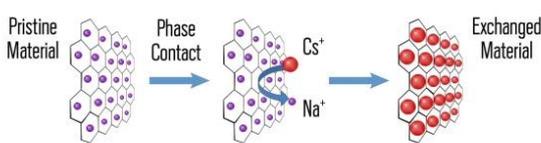
# Patent Pending Ion Specific Media

**High Performance    Excellent Capacity    Completely Vitrifiable**



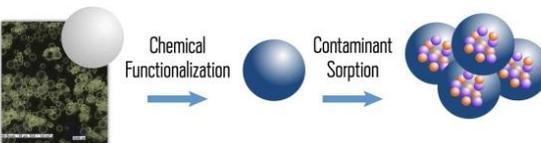
**SSM**  $^{90}\text{Sr}$     **AGH**  $^{129}\text{I}$     **EH**  $^{137}\text{Cs}$     **KH**  $^{137}\text{Cs}$     **SMZ**  $^{99}\text{Tc}$

**Case Study: Ion-Exchange Reaction in Kurion - EH**



**Herschelite Family – Used at 1F**

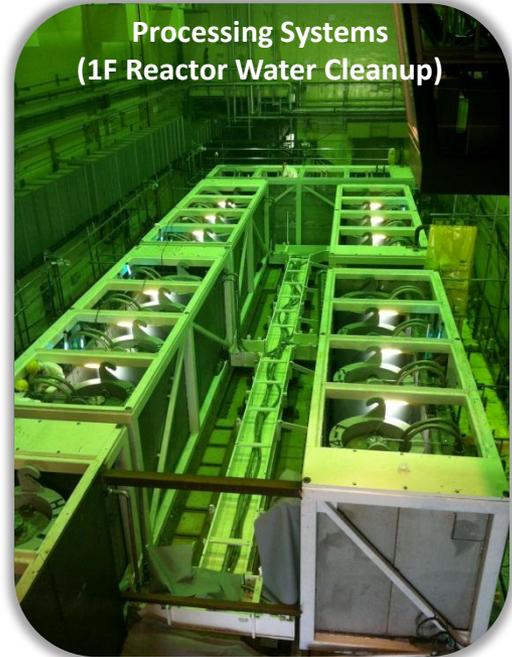
**Case Study: Porous Glass Microspheres**



**Glass Microsphere Family**



Use where high performance Water Cleanup is a priority, e.g. Ponds, Catch Basins, Spent Fuel Pools and Reactor Water

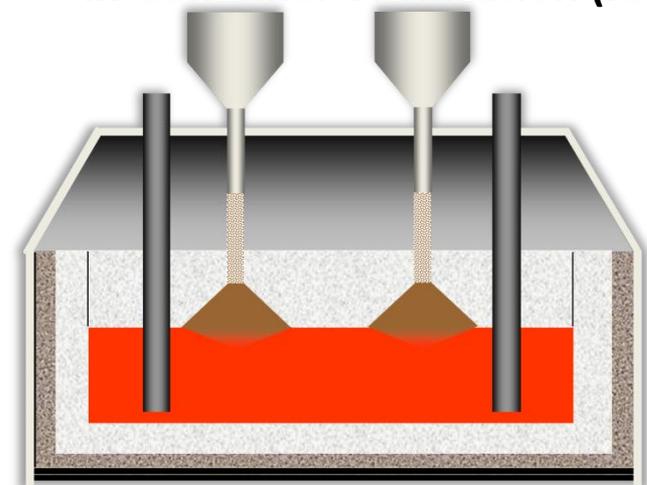


Minimizes Waste Volume – Enhances Vitrification – Protects Environment

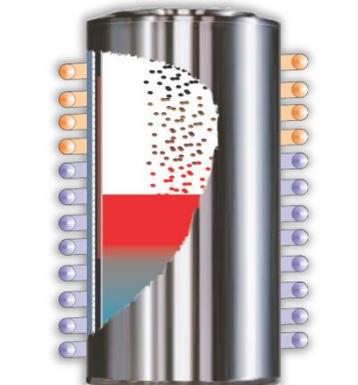
# Vitrification – Ensures Long Term Isolation

## In-Container Vitrification (ICV™) Technologies

- ✓ Modular
- ✓ Single Use Container (ICV™)
- ✓ Wide temperature ranges
- ✓ Wide waste and glass chemistry ranges
- ✓ Processing flexibility
- ✓ Reduced pre-treatment
- ✓ Robust
- ✓ Reliable
- ✓ Simple

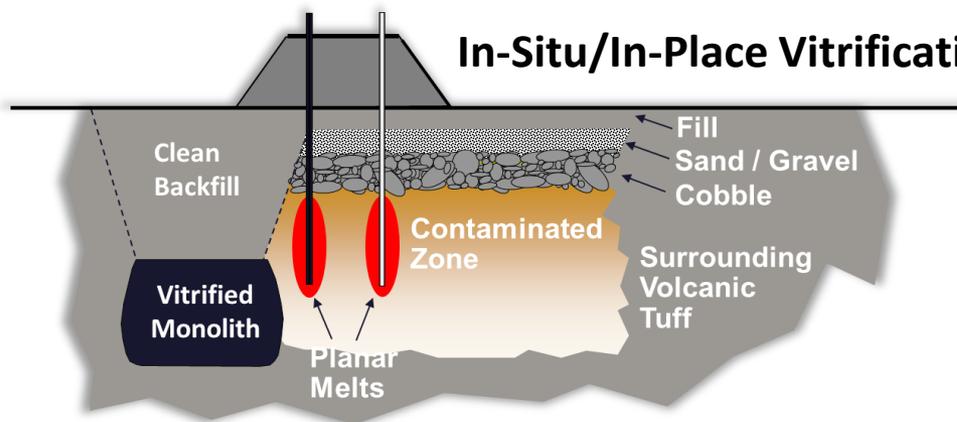


GeoMelt® ICV™



Modular Vit. System (MVS®)

## In-Situ/In-Place Vitrification

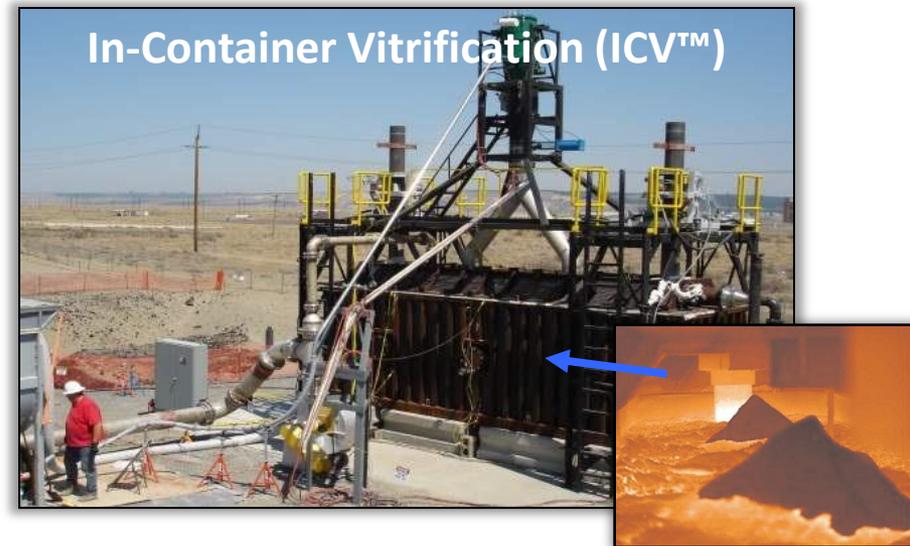


GeoMelt® Subsurface Planar Vitrification (SPV™)

Low Cost + Fast Deployment ≈ 26,000 MT of Vitrified Waste To-Date

# Waste, Soil and Debris Stabilization

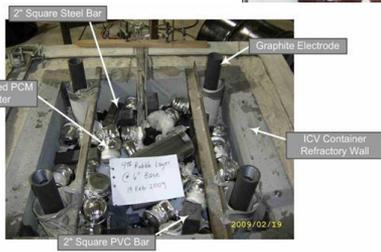
- Stabilize wide range of waste and debris
- Treat soils, sludges, sediments and mine tailings contaminated with organic, inorganic, radioactive and hazardous compound. Applications include:
  - Underground plumbs of contamination,
  - Stabilization of pits of contaminated surface soils and debris, and
  - Flow channels and barriers
- Used at numerous locations (e.g. [US DOE Oak Ridge](#), [Transuranic waste sites](#), [UK](#), [Australia](#))



Magnesium Metal Rods & Soil

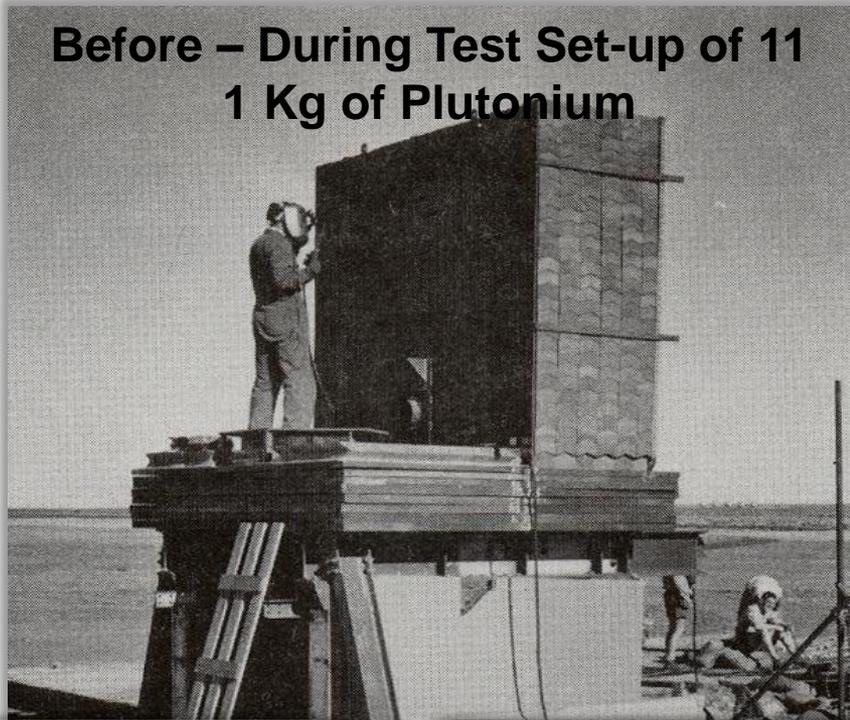


Clinoptilolite/Sand Slurry



Recycled Filters. Steel Bars, etc.

# Cleanup of British Nuclear Test Area at Maralinga, Australia



**Before – During Test Set-up of 11 Kg of Plutonium**



**Hood Over Pit Prior to Treatment**



**After Detonation**



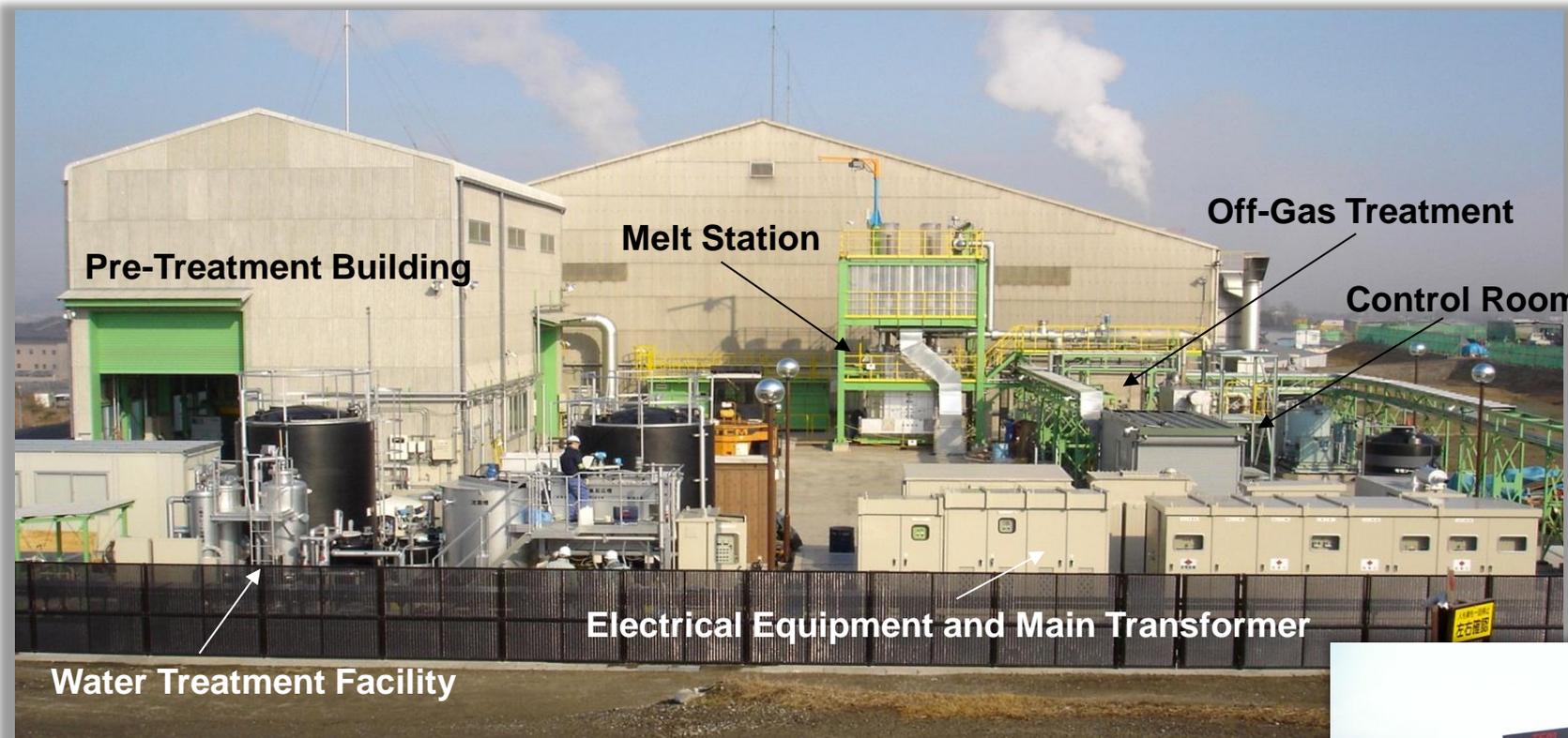
**Typical Burial Pit**



**500 Ton Vitrified Monolith Broken Open for Inspection and Sampling  
(Pu retention in the glass >99.99%)**

**350,000 M<sup>3</sup> of soil & debris removed from an area of more than 2 Km<sup>2</sup>**

# GeoMelt<sup>®</sup> Waste Treatment Plant – Mie Prefecture



## **Kurion Vitrification Licensee/Affiliate**

In Operation since 2003

Hazardous Wastes ~500 MT/year

Mie Prefecture, Japan

# Kurion Technologies Work Together

- **Ion Specific Media**
  - Ultra high performance minimizes the waste stream volume
  - Very robust
  - Flexible applications across waste, catch basins, ponds, streams and groundwater
  - Proven at Fukushima Daiichi plant
- **Vitrification-Friendly**
  - Volume reduced by factor of 5,
  - Reduced pretreatment,
  - Reduced waste canisters, handling, disposal,
  - Reduced off-gas, and
  - Accelerated compliance



**Dramatically Reduced Lifecycle Costs & Accelerated Project Schedules**

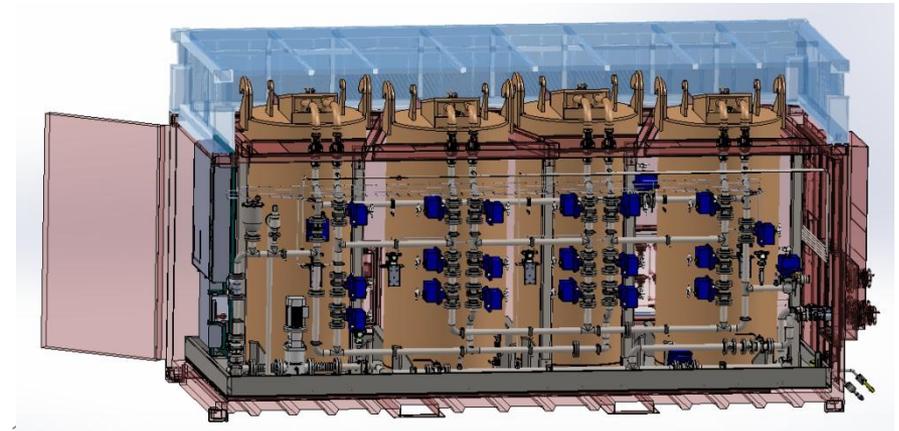
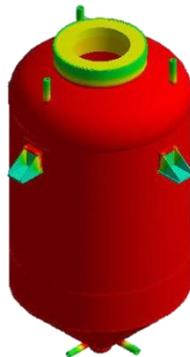
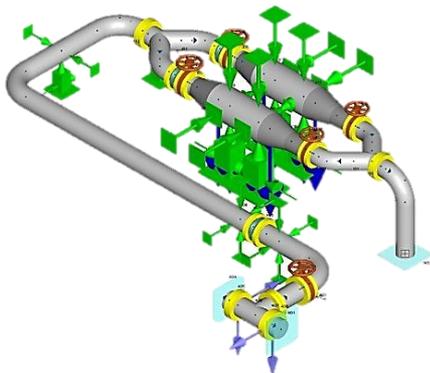
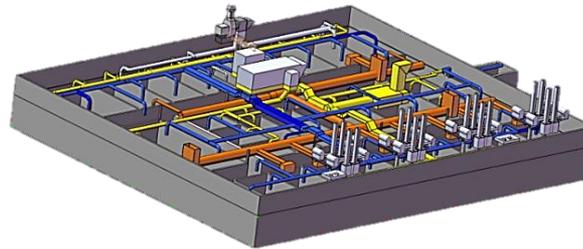
# Detritiation Technology



- Proven light water detritiation
- Process inlet water of low tritium activity ( $1 \times 10^6$  to  $5 \times 10^6$  Bq/l) to achieve an effluent of less than or equal to  $6 \times 10^4$  Bq/l
- Very large throughput possible

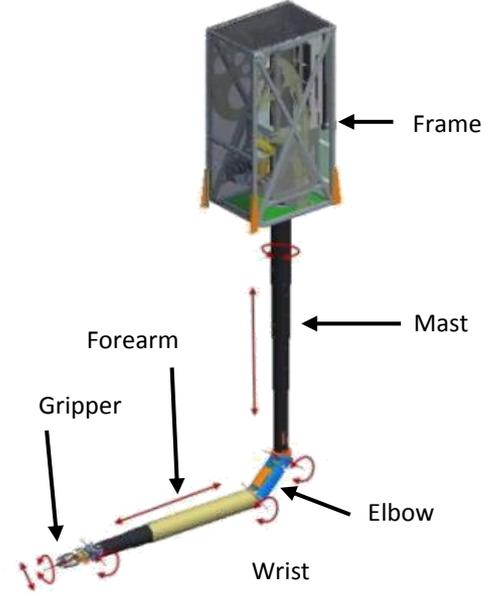
# Nuclear Facility Engineering Services

- Design & Analysis
  - Systems, Structures & Components
  - Process systems
  - Nuclear Ventilation
  - Seismic/Structural
  - Pressure Vessels
  - Demolition and Decommissioning



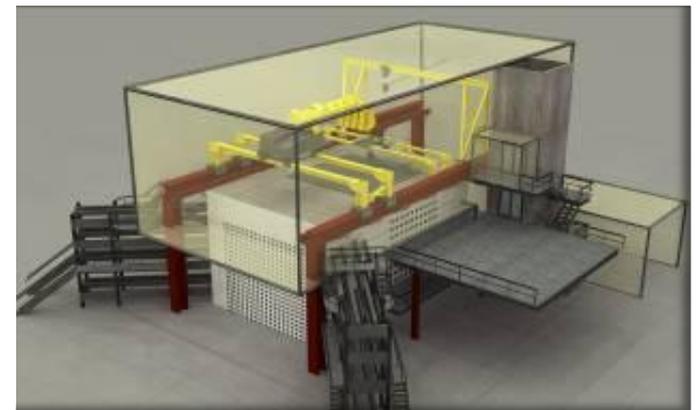
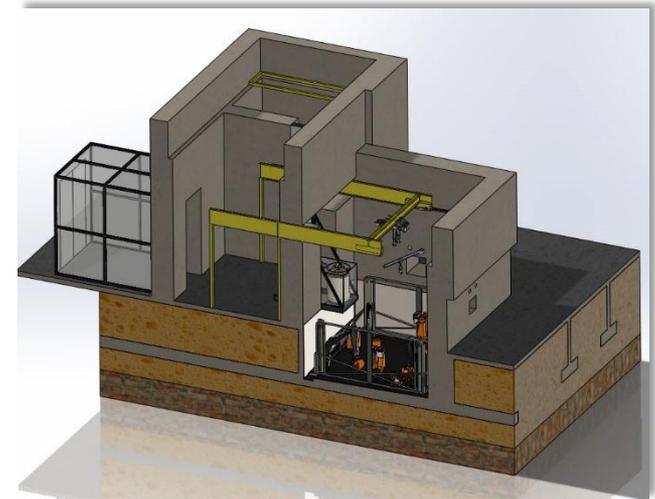
# Remote Systems for High-Hazard Environments

- Manipulators
  - Inspection
  - Size Reduction
  - Remote Tools
  - Waste Handling
  - Sludge Removal
  - Cleaning
- Heavy Equipment
  - Excavators
  - Crane-mounted Systems



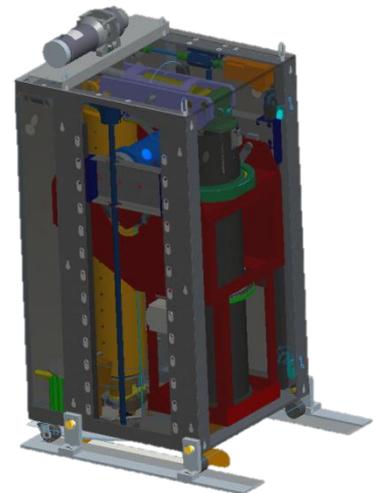
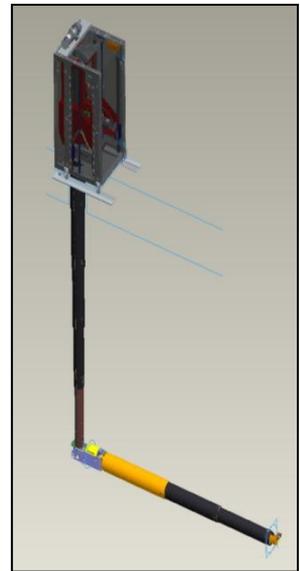
# Reactor/Nuclear Facility D&D

- D&D Process Planning
- Remote Systems
  - Size Reduction
  - Surface Removal
  - Waste Packaging
  - Solids Retrieval
  - Decontamination
  - Containment
  - ALARA



# Fukushima Inspection and Repair Manipulators

- Location: Fukushima, Japan
  - Daiichi Nuclear Power Plant Unit 2
- Date: 2012 – Present
- Scope:
  - Design
  - Fabricate
  - Test
- Status:
  - Inspection Manipulator Fabrication Ongoing
  - Repair Manipulator Design in Process



# 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**

