R&D Back-ups for Operation of the Highly Contaminated Water Treatment System in Fukushima Daiichi Nuclear Power Station

Takeshi Tsukada¹, Tadafumi Koyama¹, Takatoshi Hijikata¹, Kenta Inagaki³, Koichi Uozumi¹, Keiji Ishikawa², Shoichi Ono², Shunichi Suzuki², Mark S. Denton³, Rich Keenan³, Gaëtan Bonhomme³ and John Raymont³

¹ CRIEPI, ² TEPCO, ³ KURION
Overview of Water Treatment System in Fukushima Daiichi

Since 6/24

Desalination
HITACHI-GE, AREVA

Since 9/14

Cs Precipitation

Since 8/18

2nd Cs Adsorption
TOSHIBA/Shaw

Cs Adsorption

Since 6/17

Oil Separation
TOSHIBA

Since 6/27

WATER RECYCLE

 reactors Unit #1

Contaminated Water

Radioactivity > 10^6 Bq/ml

Impurity = sea water, oil

Amount = 100,000 m³ => 250,000 m³

Over flow?

AREVA

KURION

1200 ton/day

Oil Separation

Cs Adsorption

Desalination

Cs Precipitation
Difficulties compared with TMI water treatment system

Composition: - Radioactive elements similar to TMI
- Impurities of sea salt & mechanical oil

Throughput: 250,000ton/year (6,000ton/year for TMI)

Environment: Need to use existing building
- Limitation in weight and function of crane
- Water pool: not available => Individual shielding

Lead time: About 2 months (2 years for TMI)

Construction

Government / TEPCO

TOSHIBA HITACHI-GE KURION AREVA Others

Advisory and back-up R&Ds by Japanese Specialists

JAEA CRIEPI others

After KURION had presented the favorable properties of their zeolite and a robust system experienced in US, CRIEPI has started back-up R&Ds for TEPCO to optimize design and operation of the KURION system.
1) To measure the ion-exchange property of Kurion zeolite in equilibrium condition and column condition for confirming the properties.

2) To develop a code to simulate absorption/desorption kinetics of Cs in each Kurion zeolite column.

3) To estimate the shielding, heat generation and hydrogen generation for supporting design optimization of KURION system.

4) To carry out preliminary tests to vitrify the Cs-loaded KURION media as one of waste treatment options.

**CRIEPI’S back-ground**

Long experience in zeolite column engineering as dry-reprocessing technology for spent nuclear fuels (Spent salt treatment).
How Much Water Has Been Treated?

- 549,630 ton in total till Jan.15th
- Water level has kept around 3,000 mm O.P., where overflow can be avoided even for strong rainfall.
- KURION contributed to avoidance of the initial critical situation.
70% of Cs has been removed by KURION system

Initial Inventory: 
~ 13.6 Million Curies (5 x 10^{17} Becquerel)

Annual US reactor fleet curie disposal: 
507,000 Curies – (1.9 x 10^{16} Becquerel)

Radioactivity Level

- March 11, 2011: Earthquake and Tsunami
- June 17, 2011: KURION and AREVA Systems Start
- August 19, 2011: SARRY System Starts
- September 15, 2011: AREVA System Stopped
- December 16, 2011: Cold Shutdown Declared by TEPCO
- February 7, 2012

% of Radioactivity Removed
- AREVA 0.1%
- SARRY 30%
- KURION 70%