Lessons Learned

AREVA's Experience in JAPAN
March to July 2011

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Project roadmap (1/3)

- **Status at the plant on March 27:**
  - Accumulation of radioactive waste water due to use of sea and fresh water to cool down the reactors
  - If no solution is found, risk of overflow within 3 months
- **The need expressed by TEPCO is a decontamination facility for highly radioactive water:**
  - With high decontamination factor: > 10^6 Bq/cm^3
  - Capable of processing at a high throughput: 50m^3/hour
  - Small unit to be installed in an existant building
- **Objectives on April 8:**
  - Adapt the CEA/AREVA co-precipitation process of water treatment to the salted contaminated water present in the buildings of the plant
  - Adapt VEOLIA's Actiflo™ system to nuclear environment resulting in the Actiflo™-rad system design
  - Fabrication, delivery of equipment, on-site assembly, and start-up of active operation of the Actiflo™-rad system before end of June

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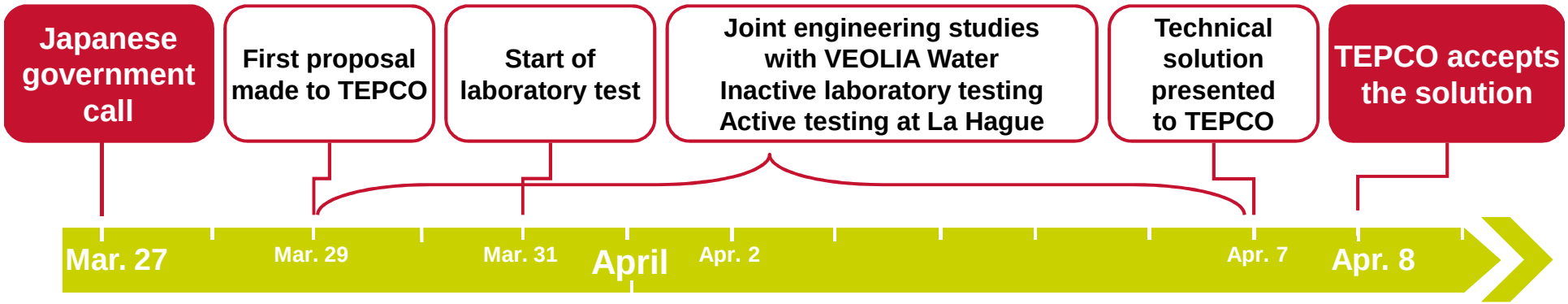
Project roadmap (2/3)

- **Upon requests from TEPCO and the Japanese Government, AREVA experts were first deployed to Tokyo with support from global AREVA resources.**
- **By the time of its completion, the implementation of the Actiflo™-rad system involved some 300 AREVA people in Japan, France, Germany, Italy and in the USA.**



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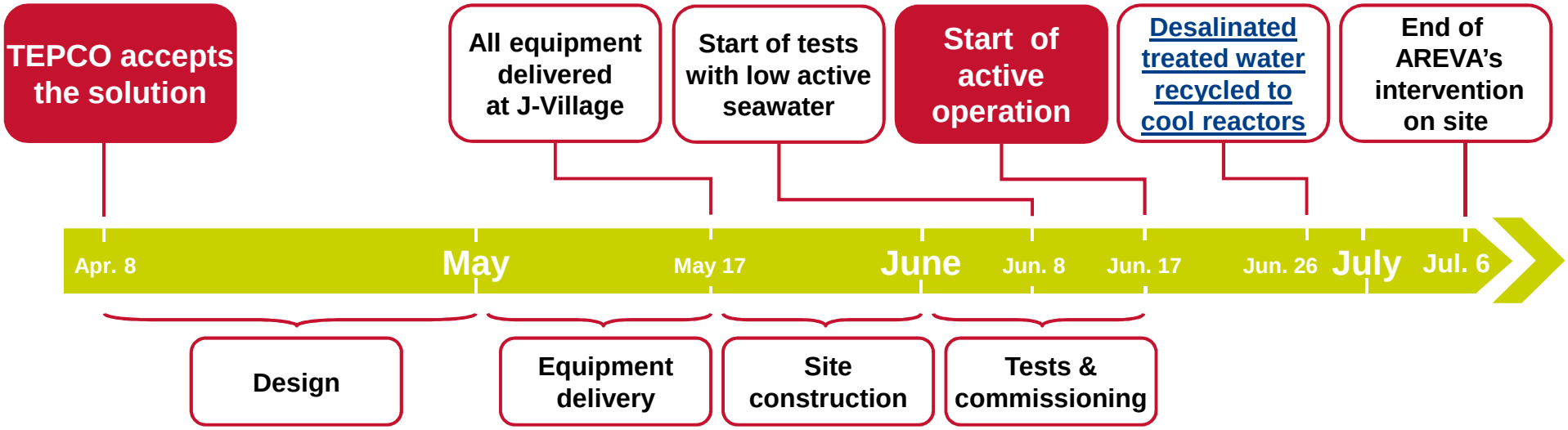
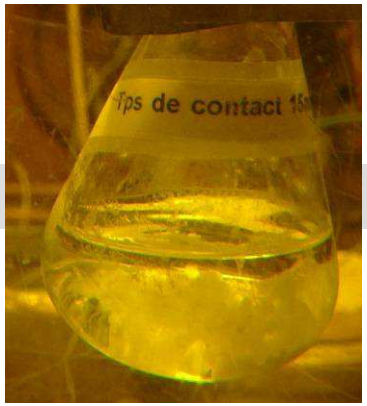
Project roadmap (3/3)





Laboratory tests

Pilot scale tests at Kawasaki

Construction in RW building

Commissioning

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The mission in FUKUSHIMA DAÏCHI

- **AREVA's mission in FUKUSHIMA in partnership with VEOLIA was :**
  - **to supervise the construction, done by JGC**
  - **to supervise the execution of the trials, done by TOSHIBA and ATOX**
  - **to execute the trials for the maintenance and for the sludge management system**
- **To do this, 50-odd AREVA people were involved on the Fukushima site from May 18 to July 6.**

"With your tremendous support, we are successfully making progress on the Roadmap towards restoration from the accident at Fukushima Daichi"

Letter from Mr. Nishizawa, President of TEPCO, to Mr. Oursel, President of AREVA (Feb. 2012)

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Introduction

- The following slides outline some basic principles formalized by the teams which participated in the program, primarily on the site.
- These principles treat:
  - Human and Organizational Factors
  - Staff and material reinforcement
  - Off-site logistics
  - On-site logistics
  - …

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To select personnel

- **Involve all concerned management and functional departments**
- **Put in place a radioprotection policy adapted to the situation**
- **Become familiar with the organization already in the field**
- **Use volunteers in possession of valid certifications for nuclear sites**
- **Select competent volunteers based on Human and Organizational Factors**

Before sending personnel

- Explain the objectives and working conditions
- Give instructions concerning behavior precautions
- Evaluate the risks concerning work safety
- Explain the measures of prevention associated with the place of work
- Give information concerning the use of specific equipment

Off-site logistics

- **A logistics platform should be installed at the perimeter of the exclusion zone for dispatching material and human means destined to the site, and for :**
  - vehicle parking
  - storage of material and equipment
  - distribution point for disposables (Tyvek suits, masks, gloves...)
  - cloakrooms
  - administrative checkpoint
  - distribution point for drinks and basic food stuffs
  - warehousing for low-level radioactive waste
  - means of communication (web-access, dedicated network...)
  - infirmary, medical center
  - decontamination airlocks
  - personal exit control airlocks
  - …

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Logistics in the exclusion zone

- **Exclusion zone should be made more accessible by securing the contamination and by placing steel panels on the ground to reduce the dose rates and to limit the dispersion of contamination due to the wind or to vehicle traffic.**
- **Vehicles assigned to the exclusion zone must be identified and their circulation must be restricted to limit the dissemination of contamination.**
- **The supply vehicles (fuel, reagents, etc.) necessitate imperative intermediary buffers.**
- **The work should be done essentially outside, a pre-equipped confined safe haven must exist on the site.**

The safe haven

- **It is the main gathering point :**
  - for management
  - for meetings
  - for meals, drinks
  - for restroom facilities
  - for cigarette breaks
  - …
- **Access should be made through a decontamination airlock and:**
  - facilitate undressing in the entry points to accelerate the flows
  - reinforce discipline, which is the priority despite the very dense population
  - ensure permanent cleanliness of the locales and immediate evacuation of waste by specialized teams
  - maintain hygienic sanitation despite high frequency (permanent cleaning team)

Essential prerequisites

- **On site, need for a safe haven operational 24 hours / day and**
  - With a robust and trained local crisis team composed of leaders and sufficient, competent, trained personnel adapted to a wide range of crisis situations
  - With material present on the site to remedy all anticipated scenarios from the first hours of the crisis,
  - Need for on-site means to inspect and evaluate the state of the site just after the accident
- **Off site : Capability to mobilize sufficient and competent personnel and complementary material within hours and for several weeks to the site in accordance with its needs (Response Force)**
- **Importance of having personnel management before, during and after the crisis**

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Path forward in France (1/2)

- AREVA acquired important feedback in all areas of extreme crisis management and in the organization of accident sites.
- This feedback was used to identify part of the set of safety systems defined as the “hardened core” that must resist beyond design threats and conditions.
- AREVA decided to implement a National Response Force, the F.I.N.A. (Force d’Intervention Nationale Areva), which consists of equipment and people specifically trained, able to be deployed to any AREVA site in FRANCE within hours.
- AREVA is also reviewing its crisis organization particularly the organizational and human factors on both the local and national levels.

Path forward in France (2/2)

- **In cooperation with EDF, design of a mobile water treatment / decontamination unit. The project « FARN – M2IN – Emergency Water Treatment Unit » will provide solutions for:**
  - matching accident scenarios
  - maintaining mobility (transported and deployed on the accident site)
  - meeting the nuclear safety requirements
  - training, maintenance and potential functions for non-accidental use
- **Participation in national working groups to study crisis organization, inter-site support,…**
- **Participation in the government project concerning nuclear crisis management**

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Path forward in JAPAN

- **AREVA proposes in collaboration with CEA a complete series of efficient environment characterization tools, deployed together with Japanese partners, to optimize remediation work in the Fukushima region:**
  - Soil measurement and sorting unit
  - Road characterization and marking unit
  - Forest and roof monitoring by helicopter
  - Underwater characterization by submarine
- **AREVA has proposed its support to TEPCO in different domains:**
  - Unloading of spent fuel from reactor pools
  - Overall management for solid and liquid waste or technologies for the treatment and conditioning of certain types of waste
  - Means for decontamination, necessary to penetrate into the reactors
- **On the Japanese reactors, establish what has been proposed to other utilities within the framework of the *Safety Alliance* program, AREVA proposes :**
  - Passive hydrogen recombiner system
  - Filtration system for the first confinement barrier
  - Backup emergency generators with control-command systems for associated safety

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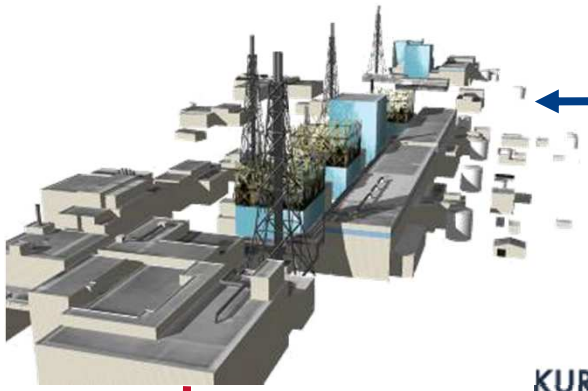
Thank You for Your Attention

Effluent Treatment Installed by TEPCO in June 2011



≈ 40 m³/h

Decontaminated desalinated water

up to 25 m³/h

≈ 20 m³/h

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VEOLIA WATER
KURION
HITACHI
AREVA
VEOLIA WATER
TOSHIBA

Contaminated Water

≈ 50 m³/h

Cs Adsorption

Co-precipitation

Reverse Osmosis

≈ 30 m³/h

Evaporation

Salt water containing isotopes incl. Cs, Sr, …

1st Cs adsorption
100 < DF < 1000

Decontamination
1000 < DF < 10000

Desalination

Waste columns

Sludge

Concentrates

Interim storage

Interim storage

Interim storage

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F.I.N.A definition

- FINA is a well-structured national emergency response force, grouping trained AREVA volunteers and accompanying material to be mobilized:
  - on any AREVA site under a crisis situation
  - at the national level
  - to relieve and complement site operational and emergency teams in charge of emergency activities and surveillance to avoid serious accidents
  - under 48 hours
  - in any situation regardless of the conditions on the site

- FINA is an integral part of the group's crisis organization at both the national and local levels as well as in each entities

F.I.N.A objectives

- Provide support to any AREVA site under crisis with AREVA personnel and by using complementary means coming from other units within the Group.
- Reinforce the robustness of local means through means and teams external to the effected site and even to take over specific actions appropriate to the crisis situation:
  - ensure the relief of certain teams to minimize accidents
  - re-establish and maintain safety on the sites
  - conduct necessary investigations and analyses
  - ensure the safety of people working on the site
  - execute environmental tests and verifications
  - put in place specialized temporary units:
    - **airlocks**
    - **ventilators**
    - **equipment for water purification, waste and contaminated effluent evacuation,**
    - **…**

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