Request for Information (RFI) of Innovative Approach for Fuel Debris Retrieval

December 17th, 2013

International Research Institute for Nuclear Decommissioning

Background

- As fuel removal from SFP at Unit 4 has started on November 18, 2013, Mid-to-Long Term Roadmap (RM) has shifted into the Phase-2.
- The goal of the Phase 2 is to start fuel debris retrieval in 2020. From TMI-2 experience, retrieval of fuel debris will be conducted by full submersion approach, in order to minimize workers' radiation dose.
- The latest RM, revised on June 22, 2013, emphasizes the importance to:
  - ✓ Work to accelerate milestone by outlining RM of each unit.
  - ✓ Plan Innovative approaches .
  - ✓ Build strong R&D management foundation.

Mid-to-Long term Roadmap

December 2011
(Step 2 Achieved)

November 2013

1st half of 2020
(fast case)

30 to 40 years in the future

Efforts to stabilize plant condition	Phase 1	Phase 2	Phase 3
<Cold shutdown achieved> •Achieve cold shutdown •Significantly reduce radiation releases	Period up to the commencement of the removal of the fuel from the spent fuel pool (within 2 years)	Period up to the commencement of the removal of the fuel debris (within 10 years)	Period up to the completion of decommissioning measures (30 to 40 years in the future)

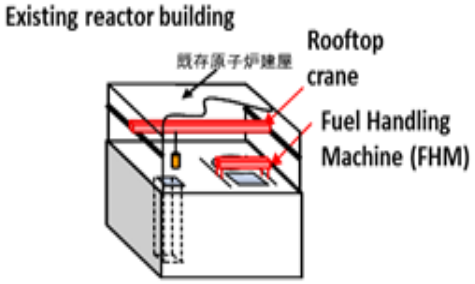
Started first fuel assembly removal from Unit 4 SFP on Nov. 18, 2013

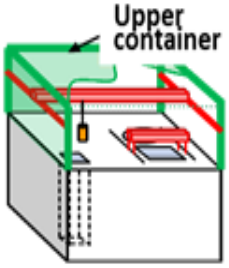
"Mid-to-long term roadmap on Decommissioning of Fukushima Daiichi NPS" was revised on June 27, 2013.

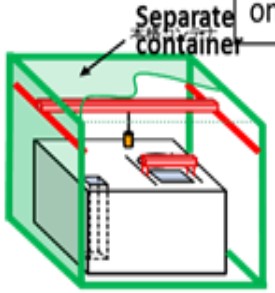
Planned Schedule for Unit 1 to 4

	Fuel rods removal from SFPs (Target schedule)	Fuel debris retrieval (Target schedule)
Unit 1	First half of FY2017 (the earliest case) ~ Second half of FY2017	First half of FY2020 ~ Second half of FY2022
Unit 2	Second half of FY2017 (the earliest case) ~ First half of FY2023	First half of FY2020 ~ First half of FY2024
Unit 3	First half of FY2015	Second half of FY2021 (the earliest case) ~ Second half of FY2023
Unit 4	November 2013 (one month earlier than the initial plan)	–

Concept for setting future plans (ex. unit 2)







<Plan 1>
When the existing reactor building can be decontaminated and the FHM can be restored

First half of FY2020
(one-and-a-half years earlier than the initial plan)

Commencement of the removal of the fuel debris

<Plan 2>
When the reactor building has sufficient seismic resistance for a container to be constructed on its upper level

First half of FY2021
(6 months earlier than the initial plan)

Commencement of the removal of the fuel debris

<Plan 3>
When the reactor building lacks sufficient seismic resistance, necessitating the construction of a separate container

First half of FY2024

Commencement of the removal of the fuel debris

*Future plans will be narrowed down in the first half of FY2014 based on the results of analysis of the likelihood of the existing reactor building's decontamination or restoration of the Fuel Handing Machine (FHM), as well as the results of assessment of the seismic resistance of the existing reactor building.

Background (continued)

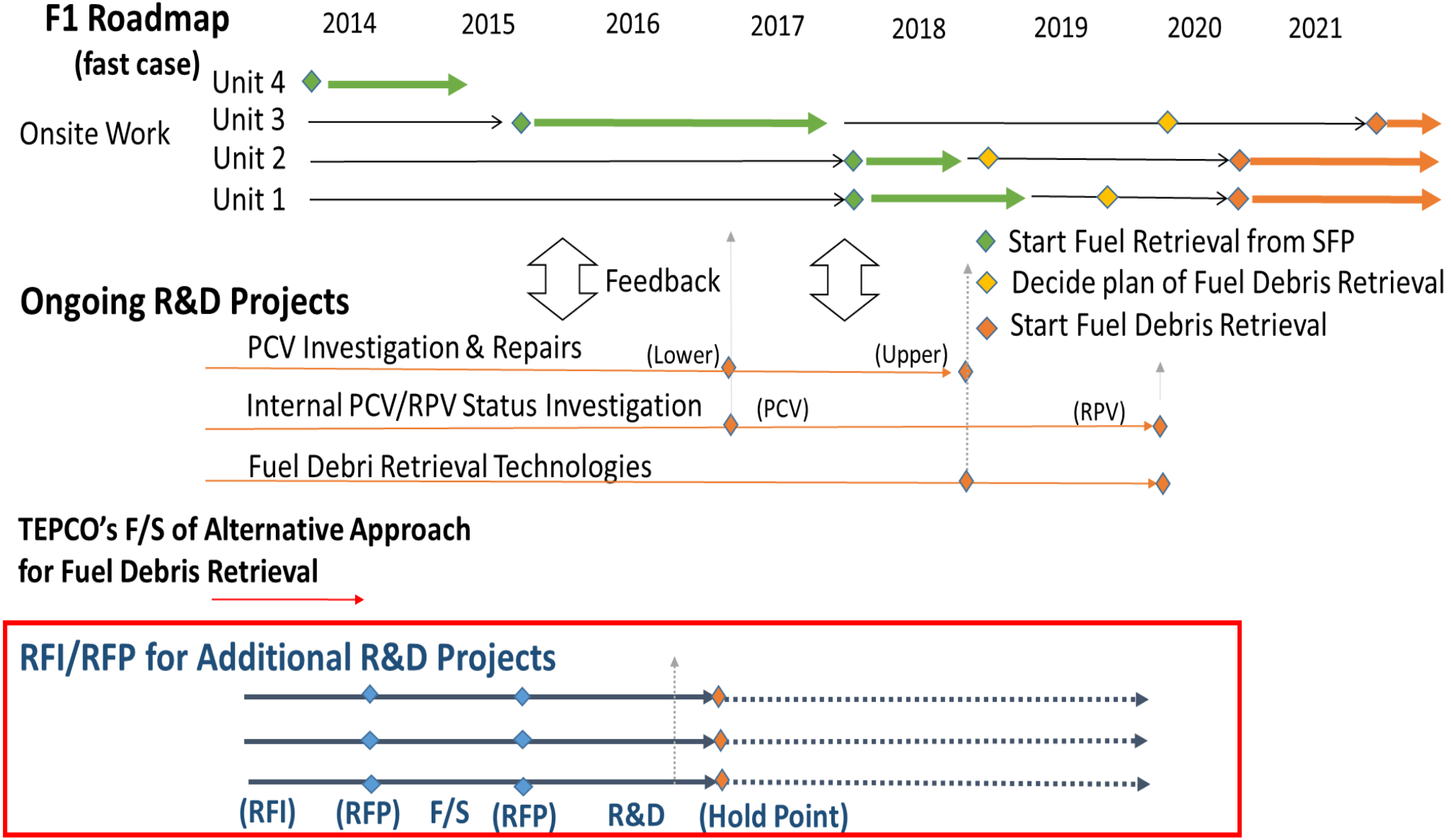
- IRID was established on August 1, 2013 to strengthen capability of integrated management of a series of ongoing R&D projects, recognizing;
  - ✓ Difficulties and complexity in dealing with challenges.
  - ✓ Necessity of multi-fold approach.
  - ✓ Importance of international collaboration.

- To ensure multi-fold approach, as well as to enable technological breakthroughs, collective knowledge and experience via interactive platform is to be pursued. This will also benefit enhancement of safety and decommissioning of nuclear facilities all over the world.

Objectives of the RFI

- The purpose of this RFI is to solicit information from industry, academia, and government affiliated agencies on issues related to designing innovative approaches to fuel debris retrieval.
- This RFI is not a funding opportunity. Responses to the RFI will be used only for planning additional R&D programs. Preceding conceptual study (C/S) and technology feasibility study (F/S) will be initiated from spring/summer of 2014, though it is subject to the governmental and Diet direction of budgeting and approval.
- In addition, we hope this RFI initiative encourages collaboration and alliance.

Decommissioning Roadmap and R&D program



Topics for RFI

Topic-A: Internal PCV/RPV Investigation

A-1: Conceptual study on alternative approaches

[Example]

- Conceptual ideas to put investigation equipment such as cameras into PCV/RPV.
  - Applying existing through-bore such as piping and penetrations.
  - Boring new penetration.
  - Method for shielding of through-bore and operation of equipment with the object of reduction of radiation exposure.
- Methods of estimating the position of fuel debris by measuring from outside of PCV.

A-2: Technologies required for Internal PCV/RPV investigation

[Example]

- Advanced measurement technologies (camera, dosimeter, thermometer etc.)
  - high performance optical instrument (camera etc.)
  - Other technology for measurement (ultrasonic wave, laser etc.)
  - Technology for controlling measuring instrument, information transmission
- Technology of identifying whether a material in the core and PCV is debris or not by evaluating its nature.

Topics for RFI

Topic-B: Fuel-Debris Retrieval from PCV/RPV

B-1: Conceptual study on innovative approaches to fuel debris [Example]

- Conceptual idea of retrieving fuel debris from PCV and RPV without submerging PCV, the comparison to the submersion scenario, etc.

(a) Accessing and removal of fuel debris from Top side of PCV/RPV under water.

(b) Accessing and removal of fuel debris from Top side of PCV/RPV in atmospheric condition*.
- By letting down operation room shielded enough.

(c) Accessing and removal of fuel debris from lateral side of PCV/RPV in atmospheric condition*.
- By applying existing penetrations.
- By boring new penetrations.
- Methods to work under high radiation and little space environment.

(d) Accessing and removal of fuel debris from bottom side of PCV/RPV in atmospheric condition*.
- By boring new penetrations.
- Methods to work under high radiation and little space environment.

Innovative approach

Topics for RFI

Topic-B: Fuel-Debris Retrieval from PCV/RPV

B-2: Technologies for Fuel-Debris Retrieval

[Example]

◆Technologies especially required for the innovative approaches. (approaches from atmospheric condition)

- Technologies of removing fuel debris. (cutting, suction etc.)
- Equipment/Facilities such as remote controlled manipulator which can be well controlled even from long distance.
- Technologies of shielding radiation emitted by high-dose fuel debris.
- Equipment/Facilities that operate under the high radiation environment.
- Equipment/Facilities for boring building concrete or PCV wall to access from lateral side or bottom side of PCV/RPV.
- Technologies of stable storage of fuel debris in PCV/RPV prior to retrieval.

Phased Approach

Phase 1:

- RFI for conceptual study (C/S) & technology feasibility study (F/S)
  - Topic-A: Innovative approach for fuel-debris retrieval
  - Topic-B: Internal PCV/RPV status investigation

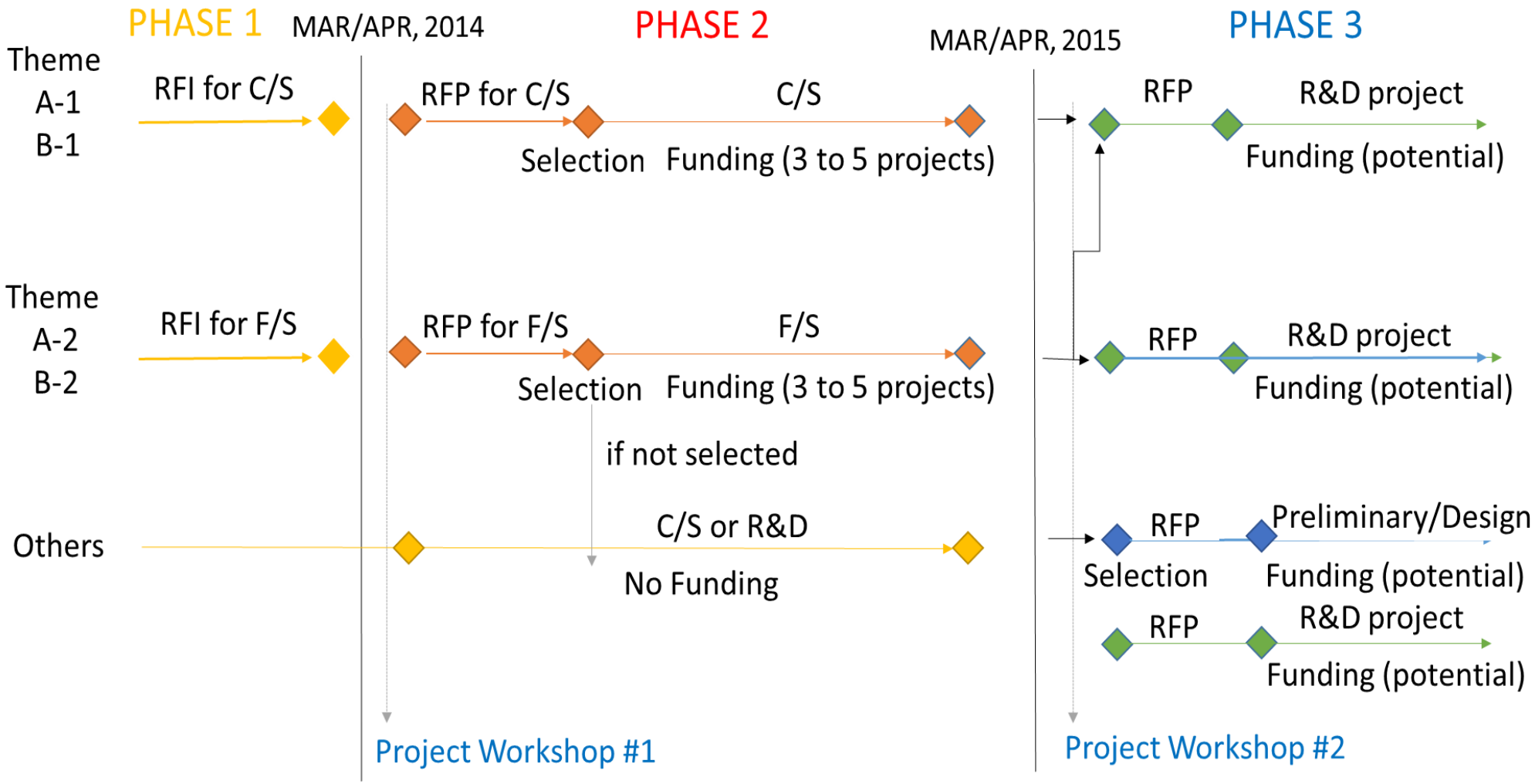
Phase 2:

- RFP and Implementation of C/S & F/S

Phase 3:

- RFP and Implementation of R&D program

Program Structure



Procedure for setting RFP specifications

- Based upon responses to the RFI.
- An independent team of specially assigned experts, established in IRID, would set detailed RFP items and specifications, while;

✓Taking into consideration the latest updates of decommissioning of the Fukushima Daiichi NPS.

✓Working with external experts as review panel.

Project Workshop

- Planned in Spring 2014.
- Respondents to this RFI are to be invited.
- Objectives
  - ✓ Share latest updates of decommissioning activities of Fukushima Daiichi NPS and relevant R&D outcomes.
  - ✓ Discuss next steps based upon responses to the RFI.
  - ✓ Encourage collaborations/alliances among respondents.

Restriction of Information submitted

- Submission contents shall be;
  - ✓ handled only by an independent team of specially assigned experts, established in IRID, under appropriate professional code.
  - ✓ shared by external experts for the limited purpose of developing RFP specifications of new program.
  - ✓ reported to Japanese government and to be shared by TEPCO.
  - ✓ disclosed in case as specified explicitly in submission forms.
- Details will be announced later in the RFI procedure.

Schedule and Point of contact

2013

- ✓ November 29 : Website is open
- ✓ Mid December : Procedure for RFI is to be announced

2014

- ✓ Late January : Deadline of RFI
- ✓ Feb/March : Review of responses
- ✓ Late April : Project Workshop
  RFP of C/S and F/S to be followed

Contact to
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