The safeguards activities for LWRs with MOX in Japan

- Remote data-driven safeguards -

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Nuclear fuel cycle in Japan
Basic principle of MOX fuel utilization

Basic principles

- **Saving limited resources**
  Establishment of practical nuclear fuel cycle is getting essential to stable and continuous supply of electric power over the future.
  - Recovered Plutonium and Uranium from reprocessing plants are recycled in Japan.

- **Implementation of International Commitment**
  - No surplus Plutonium are retained in Japan.
  - Plutonium consumption by exclusive utilization as fuels is well-matching to the commitment.
MOX utilization plan in Japan

Overview of the plan

- 16 to 18 LWRs are scheduled to receive or load MOX fuels up to 2015 as of today
- Full MOX type ABWR, Ohma reactor, will start operation in 2014
- Large scale Reprocessing plant and MOX fabrication Plant will start operation accordingly
Recent situation of returned MOX fuels from overseas (1/2)

- SF reprocessing works have been ordered to the plants at overseas.
- MOX fabrication works, mainly at the plant in France
- Maritime transportation from France to Japan
- For recent instances, 3 LWRs [Hamaoka-4, Genkai-3, Ikata-3] in 2009, 3 LWRs [Genkai-3, Takahama-3 and 4] in 2010 have received.
- MOX fuels have been received at 7 LWRs so far including Fukushima I-3 and Kashiwazaki Kariha-3, and loaded at 3 LWRs among them.
Recent situation of returned MOX fuels from overseas (2/2)

\(<2009>\)
- 3LWRs have received.
- 1LWR have loaded.

\(<2010>\)
- 3LWRs have received.
- 4LWRs have loaded or scheduled to load.

It is estimated that safeguards activities for LWR with MOX would be considerably increased in accordance with such trend.
Description of MOX fuel receipt process (1/3)

- Due consideration with safeguards is much required for MOX fuel receipt from overseas
- The recent activities have been successfully completed under the close cooperation with France, IAEA

Points to be considered for overseas receipts

- Import transportation
  One transportation for more than one destinations, which means, 3 LWRs on average receive MOX fuels almost simultaneously.

- Receipt examination by operator
  Receipt examination by operator requires several days.

- Import fuel inspection by State authority
  Inspection by State authority is also require.

Considerable person-day efforts are require for safeguards.
Description of MOX fuel receipt process (2/3)

MOX fuel cask loading at BWR

1. Casks are loaded on a transport vehicles.
2. Casks are transported to the NPP.
3. Casks are placed temporarily in Cask Custody Building.
4. Casks are carried in the Reactor Building.

Scene of transporting a Cask

Transport Route in the Reactor Building

- Gantry Crane
- 4th Floor (Reactor Hall)
- 3rd Floor
- 2nd Floor
- Equipment Entrance
- 1st Floor

5. Cask is placed temporarily in the Cask Decontamination Pit.
6. Cask is lifted up to the Reactor Building 4FL.
Description of MOX fuel receipt process (3/3)

MOX fuel unloading from the cask at BWR

All activities except midnight suspension are under HUMS by inspectors → leading to heavy PDIs
PDI reduction efforts for the increasing LWR with MOX

Discussions with the IAEA have been started to attain more reasonable optimization of the safeguards activities without compromising the IAEA’s policy and criteria.

⇒ Review of the current ISA for LWR with MOX

As main points,

① Replacement of HUMS by inspectors with surveillance cameras
② Combination of RM (Remote Monitoring) and NDA
③ Development of more suitable ISA for the forthcoming Full-MOX ABWR, Ohma reactor, with “state of the art” safeguards equipments.
PDI reduction efforts
- Introduction of RM systems -

(1) Brief history in Japan

- RM systems have been applied to some facilities treating sensitive NM such as MOX.
- Field trials for demonstration of RM systems were carried out both at PWR type [Mihama] and BWR type [Tokai] from 1998 to 2004.
- The trials were cancelled due to starting the current ISA introducing RII (Random Interim Inspections).

(2) Introduction plan for RM systems to LWR with MOX in Japan

<table>
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<th>Year</th>
<th>2010</th>
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<td>Takahama-3,4</td>
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<td>Field trial for evaluation</td>
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<td>Introduction of RM systems</td>
<td>Field test</td>
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PDI reduction efforts - Field trials - (1/2)

(3) Introduction of RM systems to LWR with MOX in Japan

Through the Field trials at Takahama-3,4 and Ohma,
- identify the problems to be solved and improve the situation under the implementation.
- evaluate benefit/cost effect.

In case of Takahama-3,4,
① Installation of SG equipments for RM systems (April, 2009)
② Installation of RM server and data communication cables (under preparation)
③ Drafting of approach and procedure for the field trials (under preparation)
④ Field trials (From 2011)
PDI reduction efforts - Field trials – (2/2)

(3) Introduction of RM systems to LWR with MOX in Japan

In case of Takahama-3,4, actual costs are roughly as followings;

① SG equipments installation (already installed this time)
② Cabling for RM systems  €160,000
③ Data communication  €58,000/month

\[ €1=\text{¥110} \]

PDI reduction effect gained from IIV cancellations

2~3 PDIs for each LWR

Through the discussion with the IAEA regarding the development of ISA for Ohma reactor, there is a view that HUMS by inspectors would not be completely replaced with RM systems consisting of only surveillance cameras……

⇒ Considering the combination with NDA devices
PDI reduction efforts - RM + NDA - (1/3)

(1) Combination of RM+NDA proposed by the IAEA

- Regardless of CoK maintenance, re-measured by NDA devices at fuel inspection pit. → After that, maintain the CoK

While PDI reduction would be expected, some NDA devices are required.

Benefit/Cost effect evaluation is important
PDI reduction efforts - RM + NDA - (2/3)

(2) Combination of RM + NDA
(Cost estimation for the planned 16 LWRs with MOX in the future)

Initial cost
- Cabling
- SG equipments
- SG equipment installation
- Investigation

Abt. €33M

Maintenance cost
- Data communication
- Maintenance for installed systems
- IAEA staff
- JSGO/NMCC staff

Abt. €0.9M/year

Cost effective ????
PDI reduction efforts - RM + NDA - (3/3)

(1) Practicable consideration

It is not practical to apply RM and NDA to all cases in a uniform way.

Classified by

Amount of MOX fuels to be loaded
Facility specific features

Review of effect evaluation for benefit/cost & PDI reduction in each case
ISIS-J (Integrated Safeguards Information System of Japan) project has been started to establish own autonomous SSAC to improve the transparency for nuclear activities in Japan.

ISIS-J will correctly and timely provide the IAEA with the useful information gained from the independent SSAC activities to enhance the confidence for our SSAC and improve the transparency for nuclear activities in Japan.

We hope this project will contribute to improve the transparency for MOX utilization in Japan.
Conclusion

- It is estimated that safeguards activities for LWR with MOX in Japan will be increased in accordance with the increasing LWR with MOX in the future.

- In this context, reasonable optimization of safeguards activities are under review with the IAEA.

- It is important to select and apply the appropriate measures considering benefit/cost effect evaluation, MOX utilization plan and facility specific features.

- While Respecting the IAEA’s inherent ability “to draw independent safeguards conclusion”, timely manner data sharing with the IAEA and provision of useful information from ISIS-J activities would be important for our improving autonomous SSAC with RM systems application.
In conclusion, it is to be desired that more suitable IS approach would be developed under the close cooperation with the IAEA, referring to the related practices in other countries, and applied universally in the future.

It would be appreciated if the IAEA would have close and continuous cooperation.