Current State of Japan's Nuclear Fuel Cycle Projects

Japan Nuclear Fuel Ltd.

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Fukushima Nuclear Accident

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- Japanese people engaged in the field of nuclear energy apologize for the fact that Fukushima nuclear accident has caused various negative impacts on the civilian nuclear power projects in the whole world.
- Direct cause of the accident is apparently the attack of the disastrous Tsunami that was generated by the huge earthquake of magnitude 9 in the deep offshore bottom of the Pacific Ocean.
- Japanese government and Tokyo Electric Power Co. are making every effort to keep decay heat removal, to decontaminate the spilled water, to build outer covers above the broken reactor buildings and to cleanup the surface of the ground inside and outside of Fukushima Daiichi site.
- Achievement of the cold shutdown will probably be officially announced by the government at the end of this week (Dec. 16).
- It seems, however, to take more time for all of the public people to return to their original homes near the Fukushima NPP.
- The accident has also significantly affected various programs of the nuclear energy utilization in Japan.

Effect of the Earthquake in Rokkasho

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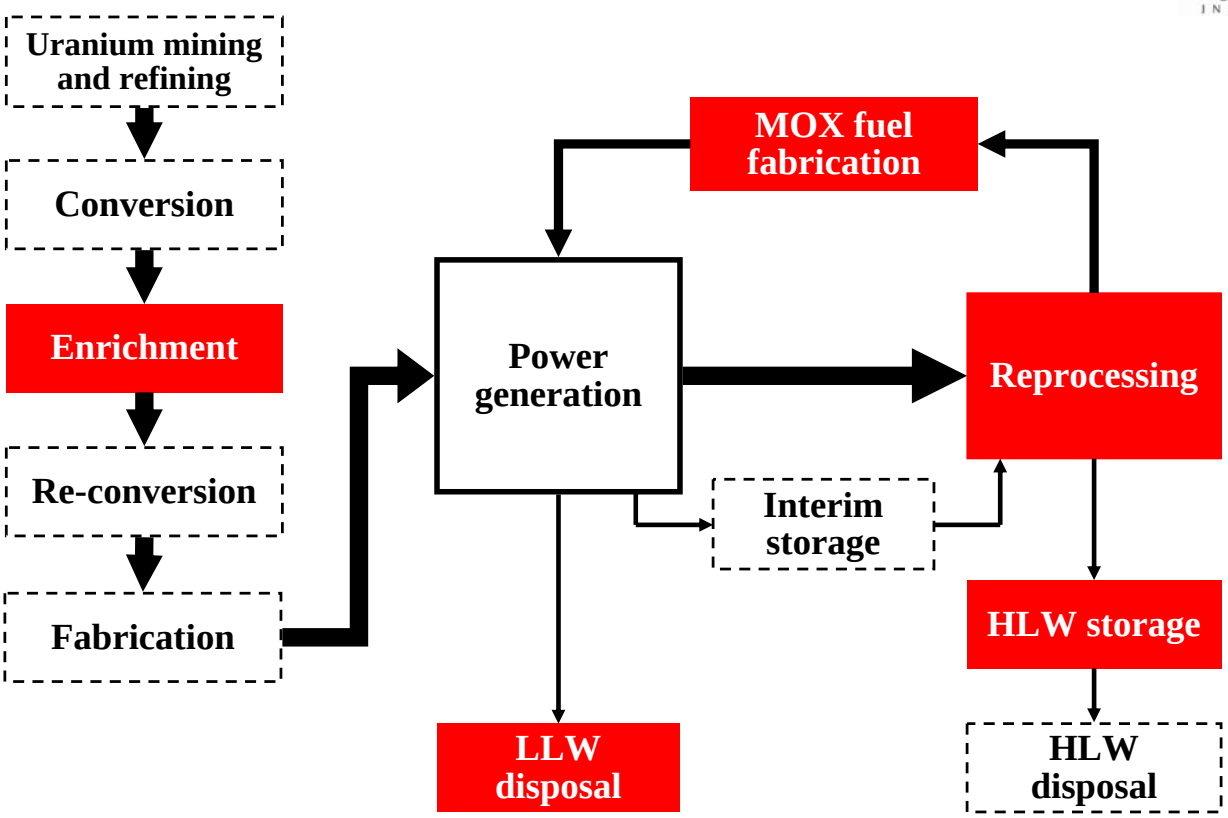
- No components of JNFL fuel cycle facilities were damaged by the huge earthquake whose epicenter was 300 km away from Rokkasho.
- Measured vibration at the base mat of JNFL facilities was only 37 gals that is less than 1/10 of the Design Basis Seismic Acceleration.
- Tsunami did not reach JNFL facilities which are located 5 km away from the seaside and 30 to 55 m above the surface of the sea.
- While the external power source was lost due to the blackout in the wide region of the northeast area of Japan on the day of the quake, all of JNFL emergency diesel generators started automatically and successfully supplied electricity to equipments important to safety.
- Although the external power was fully recovered in four days, active testing of JNFL reprocessing plant and construction of JNFL MOX fuel fabrication plant have not been re-started 9 months, because JNFL has to wait and see the discussion of the academic experts' committee appointed by the local government of Aomori.

Role of JNFL for Japan's fuel cycle



JNFL Corporate Profile

- **Company name ; Japan Nuclear Fuel Limited (JNFL)**
- **Established ; July 1, 1992**
  - **Through the merger of two preceding nuclear fuel service companies established in 1980 and 1985.**
- **Paid-in capital ; 400 billion yen ($5.1 billion)**
  - **Plus 200 billion yen ($2.6 billion) as the capital reserve.**
- **Shareholders ;**
  - **Mainly owned by 9 EPCOs and JAPCo.**
  - **Other 77 companies (banks, vendors, insurance co., etc.)**
- **Sales turnover ; 308 billion yen ($3.9 billion) in FY2010**
- **Gross assets ; 2,916 billion yen ($37 billion) at the end of FY2010**
- **Chairman ; Makoto Yagi (Chairman of FEPC, President of KEPCO)**
- **President ; Yoshihiko KAWAI**
- **Employees ; 2,455 as of November 30, 2011**

Reprocessing ; Plant design

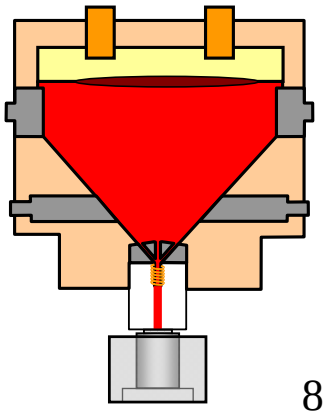
- RRP ; Rokkasho Reprocessing Plant
  - Reprocesses spent fuel discharged out of light water reactors (LWR).
  - Maximum throughput ; 800 tU/yr.

- Technologies applied in RRP ;
  - Shearing, dissolving, separation and purification ; AREVA
  - De-nitration and vitrification ; PNC (predecessor of JAEA)
  - Iodine removal ; DWK (Germany)
  - Acid recovery and waste liquid evaporation ; BNFL (UK)

- Though RRP is PUREX based, no separate pure Pu is produced.
  - PuO_2 is recovered as a mixture with UO_2 through the mixed de-nitration process.

Reprocessing ; Active testing

- Construction ; started on April 28, 1993 and 99% completed.
- Active test using spent fuel ;
  - Started on March 31, 2006 and 94% completed.
  - Operators trained in La Hague, France.
  - Supported by AREVA and JAEA.
- 425 tU of LWR spent fuel reprocessed.
  - 220 tU BWR and 205 tU PWR spent fuels.
- Recovered products ;
  - Uranium as oxide ; 364 tU
  - Mixed Pu and U in MOX ; 6.7 tHM (50% PuO_2 and 50% UO_2)
  - Fissile Pu in MOX ; 2.3 tPuf
  - Vitrified HLW in 119 canisters.
- Liquid fed ceramic melter (LFCM) for waste vitrification process remains to be tested more.



Japan's Experience in using MOX fuel

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- 2 MOX lead test assemblies in BWR Tsuruga #1 ; 1986 to 1990.
- 4 MOX lead test assemblies in PWR Mihama #1 ; 1988 to 1991.

  The above 6 fuel assemblies were discharged out of the reactors and sent to hot labs for the post-irradiation exams.
- 772 MOX fuel assemblies in Fugen (ATR) ; 1979 to 2003.

  Heavy-water-moderated, boiling-light-water-cooled.

  The world's largest MOX experience in a single reactor.
- 585 MOX fuel assemblies used by the experimental FR Joyo.
- 315 MOX fuel assemblies used by the prototype FR Monju.

  Currently 198 MOX fuel assemblies waiting for the restart.
- 72 MOX fuel assemblies are loaded in 4 LWRs today.

  32 MOX fuel assemblies in BWR Fukushima Daiichi #3.

MOX fuel fabrication

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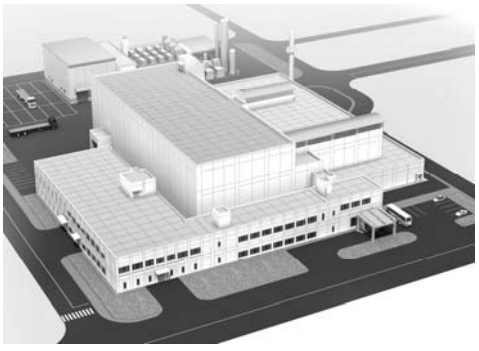
- JMOX ; Japan's commercial MOX fuel fabrication plant
  - ✧ Supply MOX fuel to LWRs in Japan
  - ✧ Maximum capacity ; 130 tHM/yr
  - ✧ Located adjacent to RRP ;

    MOX powder to be transferred through an underground tunnel from RRP to JMOX.



  - ✧ Safety design was approved by Japanese regulatory authority.
- Construction of JMOX
  - ✧ Construction started ; October, 2010.
  - ✧ Excavating work was interrupted by snowfall in winter and the discussion after Fukushima nuclear accident during 2011.
  - ✧ Expected restart of construction work ; next spring.
  - ✧ Targeted start of the commercial operation ; March, 2016.

Spent fuel to be reprocessed

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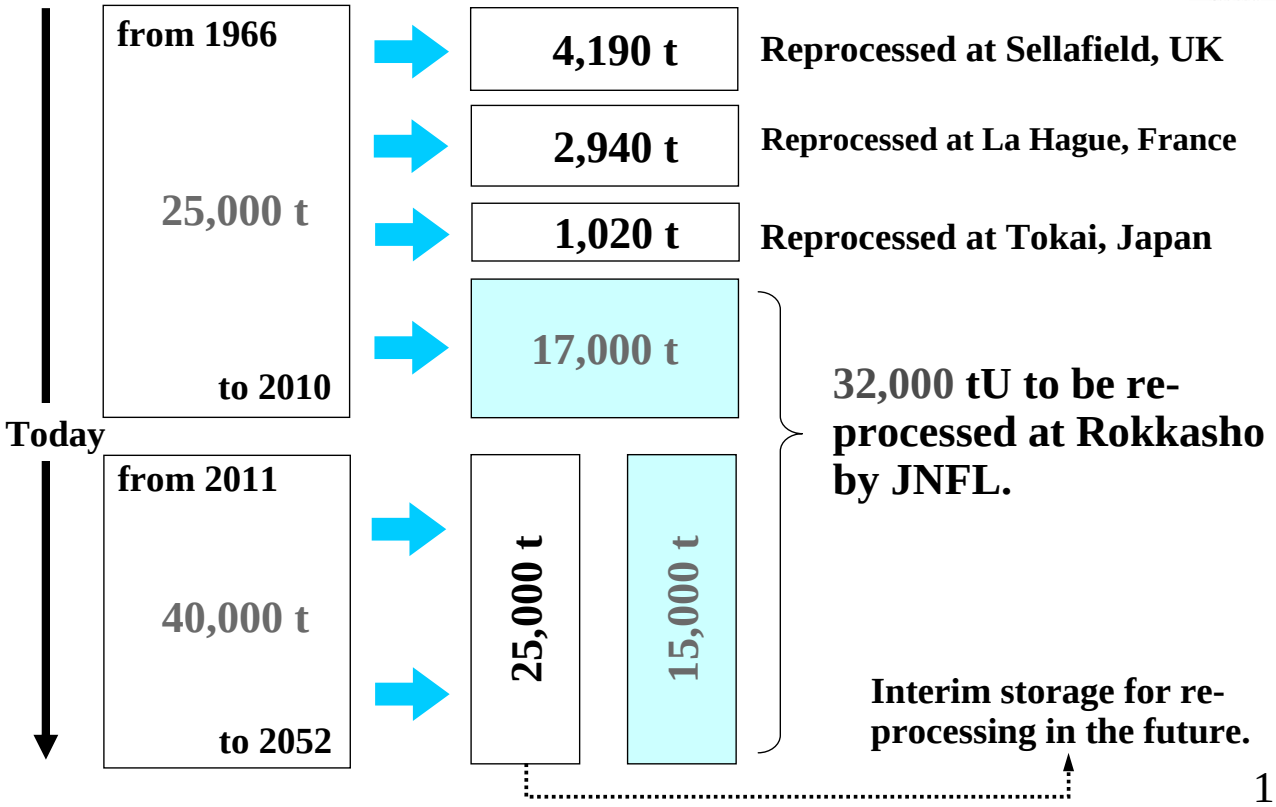

Value of Nuclear Energy

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- Nuclear fuel cost is the lowest and the most appropriate for supplying electricity to the base load.
- Fuel recycling for nuclear power improves sustainability of energy security.
- Total nuclear power generating cost coupled with closed fuel cycle has enough competitiveness against other power sources and is less sensitive to the uranium price and currency exchange rate, then stabilizes electricity retail price.
- Utilization of nuclear power decreases overseas payment for importing fossil fuel and purchasing emissions credit, then increases purchasing power for importing foods.
- The most powerful countermeasure against global warming.
- Nuclear power heavily depends on domestic industry and employment, then supports domestic economy.
- Energy supply with nuclear is the status of developed country.

Expected Energy Policy

- From the viewpoints of energy security and the prevention of global warming, the peaceful use of nuclear power has been and will continue to be very important for the sustainable world.
- Since Japan is short of domestic energy resources and its energy utilization efficiency (Energy consumption/GDP, CO_2 emission/GDP) is extremely low, the country cannot denuclearize.
  - ✧ Among other countries, Japan especially needs to fully utilize the potential of nuclear power and its capability of fuel recycling.
  - ✧ Asian countries in the vicinity use nuclear even if Japan does not.
- Politicians should conclude ;
  - ✧ Continue using some amount of nuclear energy, although it may be somewhat less than the current share of the total energy supply,
  - ✧ Keep nuclear power as one of the options of energy supply method for the future generations,
  - ✧ Review energy policy every 10 years considering new conditions in the future.