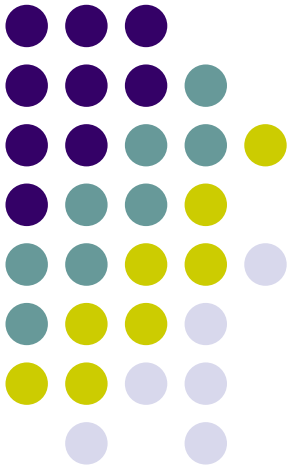
MOX Fuel Fabrication Technology

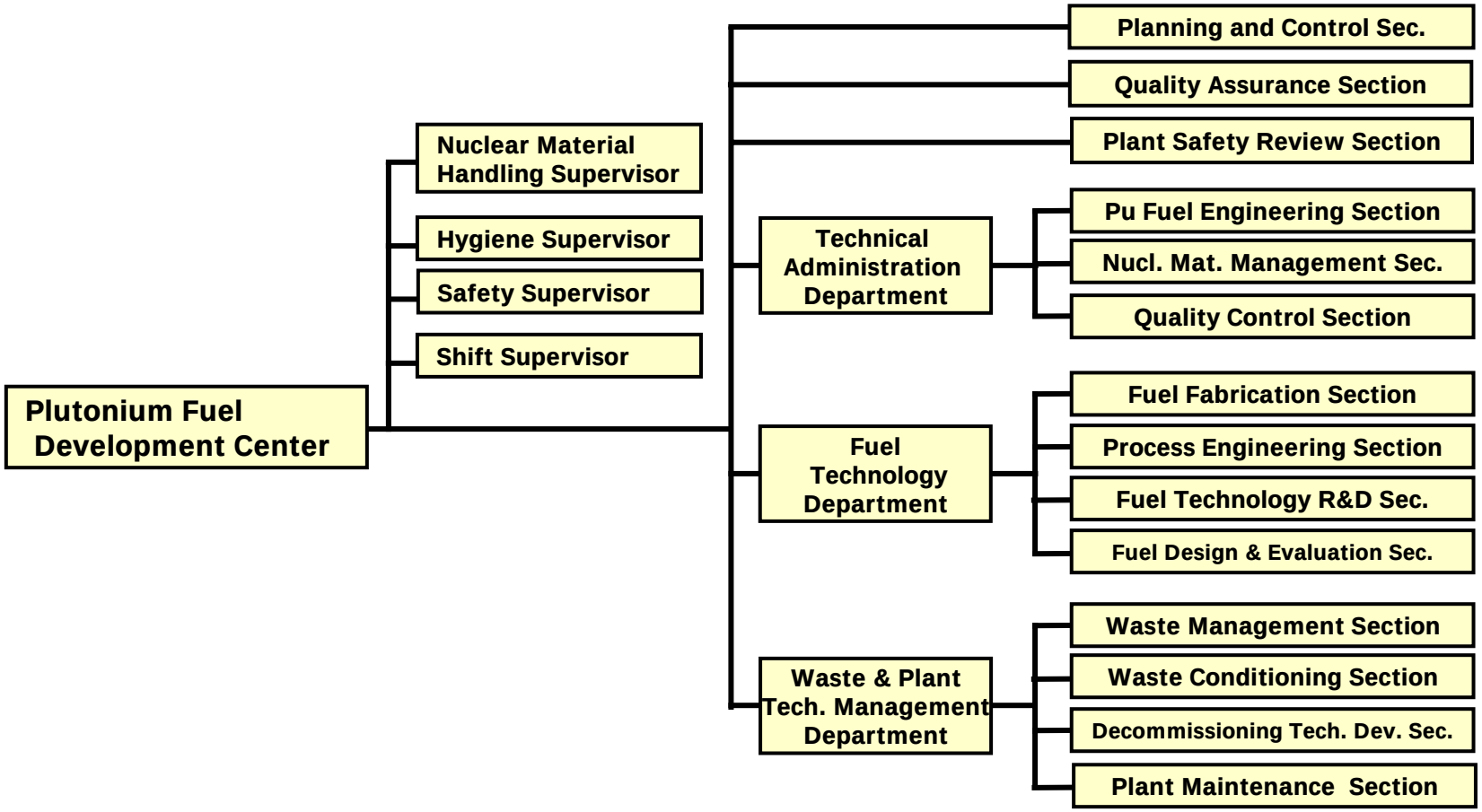
Plutonium Fuel Development Center
Nuclear Fuel Cycle Engineering Laboratories
Japan Atomic Energy Agency



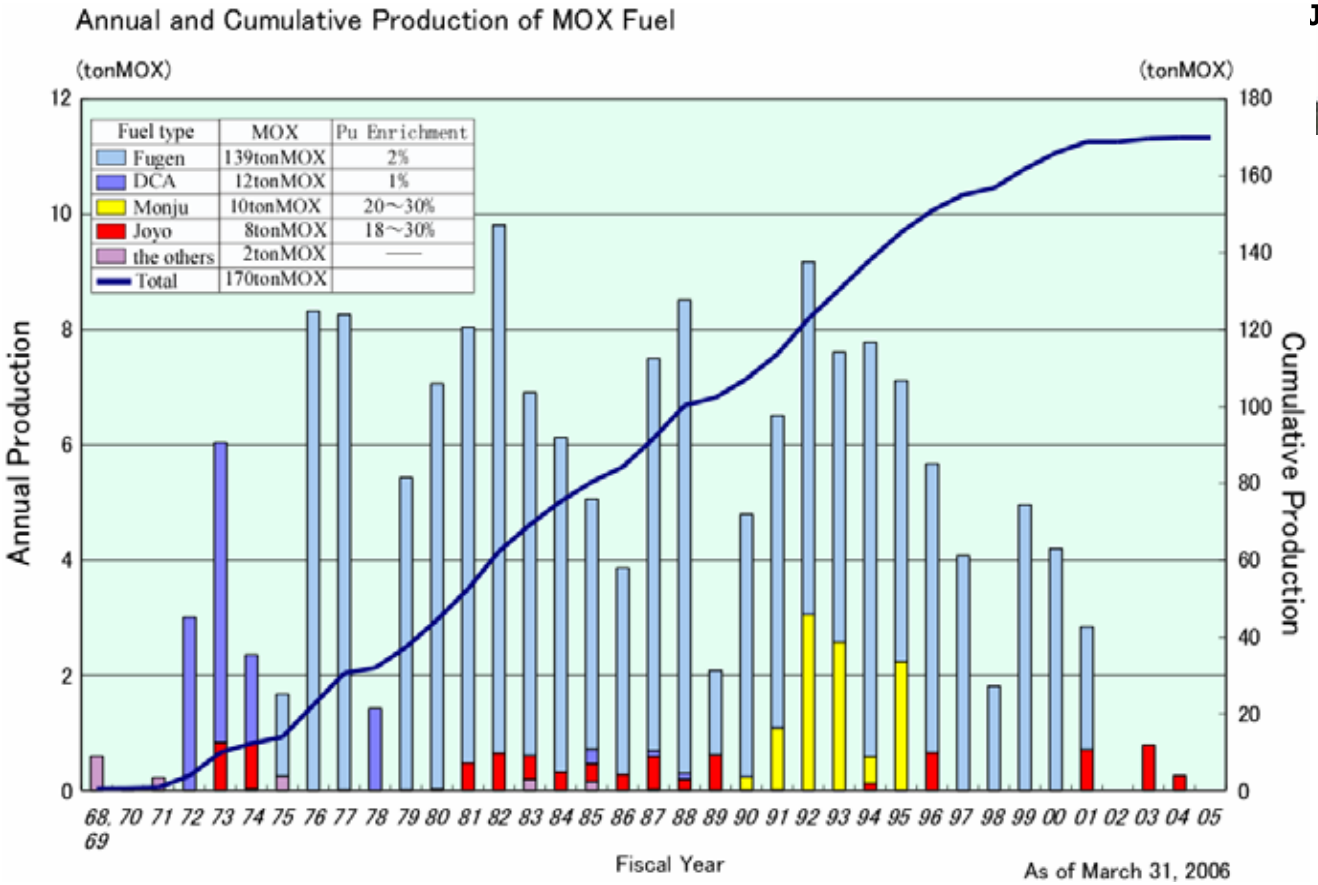
History of PFDC

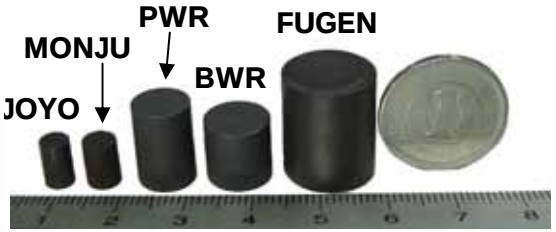
	Before PNC	PNC	JNC	JAEA
	'60s	'70s	'80s	'90s	'00s
PFDF	■Facility was constructed based on the technology introduced from US ■260g Pu was introduced from US in 1966 to start research on MOX fuel in Japan ■R&D on advanced fuels and new fabrication process in progress ▼'74: Fabrication of MOX fuel for PWR (Mihama-1)				
PFFF		■Semi-automated process equipment based on the experience gained through PFDF operation was adopted ■MOX fuel fabrication for Joyo and ATR-Fugen until 2001 ▼'85: Fabrication of MOX fuel for BWR (Tsuruga-1)			
PFPF			■Remote/automated operation was adopted based on past experience ■MOX fuel fabrication for Joyo and Monju		
Technical support for J-MOX				■MOX test ■Consulting ■Training	

Organization of PFDC



Fabrication Achievements





<FBR>
MONJU : 285 FAs
JOYO : 636 FAs

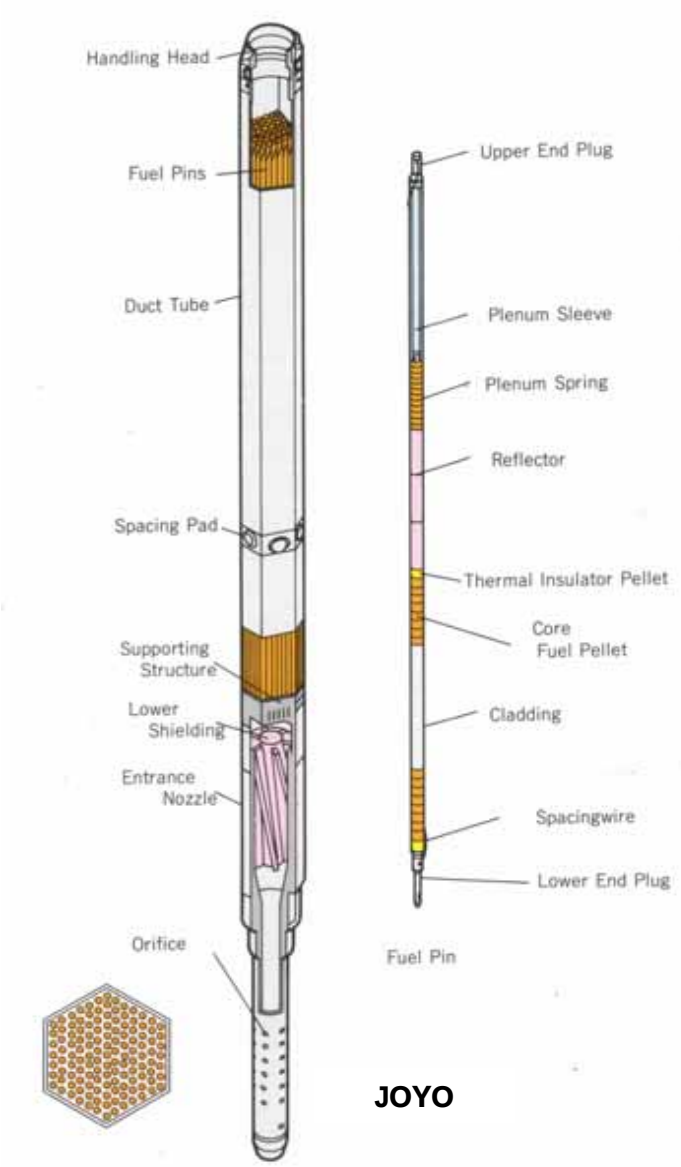
<ATR>
FUGEN : 773 FAs

<BWR>
Tsuruga No.1 : 2 FAs

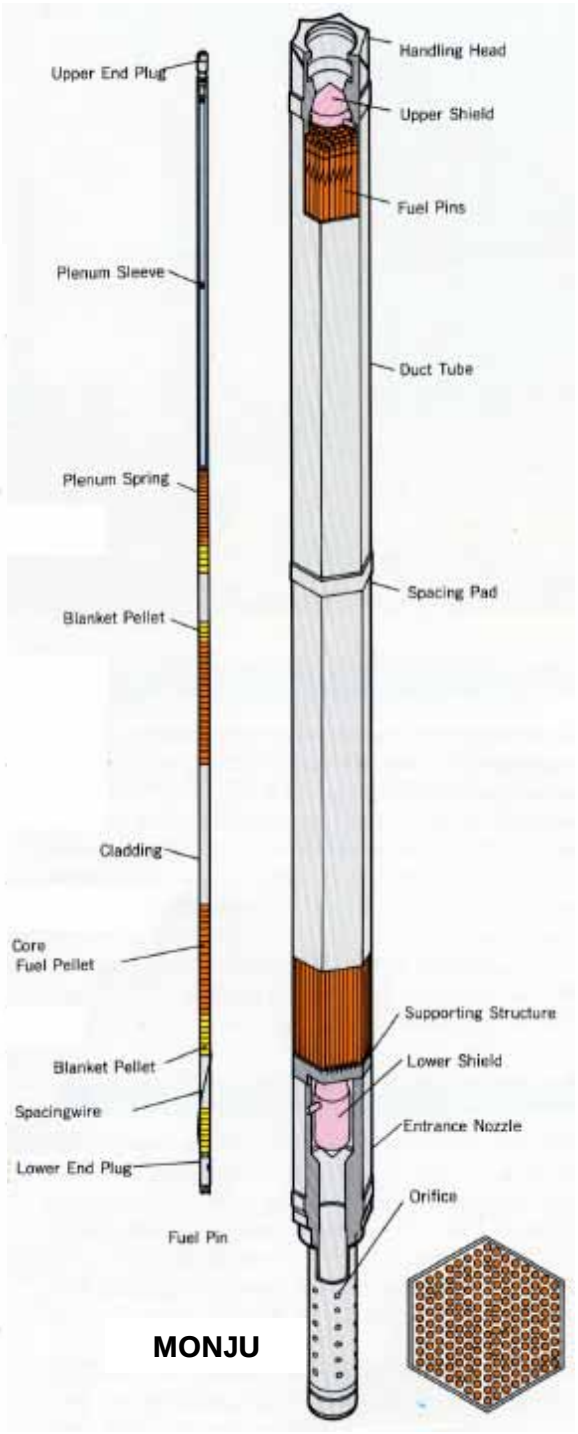
Others : 2 FAs

TOTAL : 1698 FAs

Fuels design



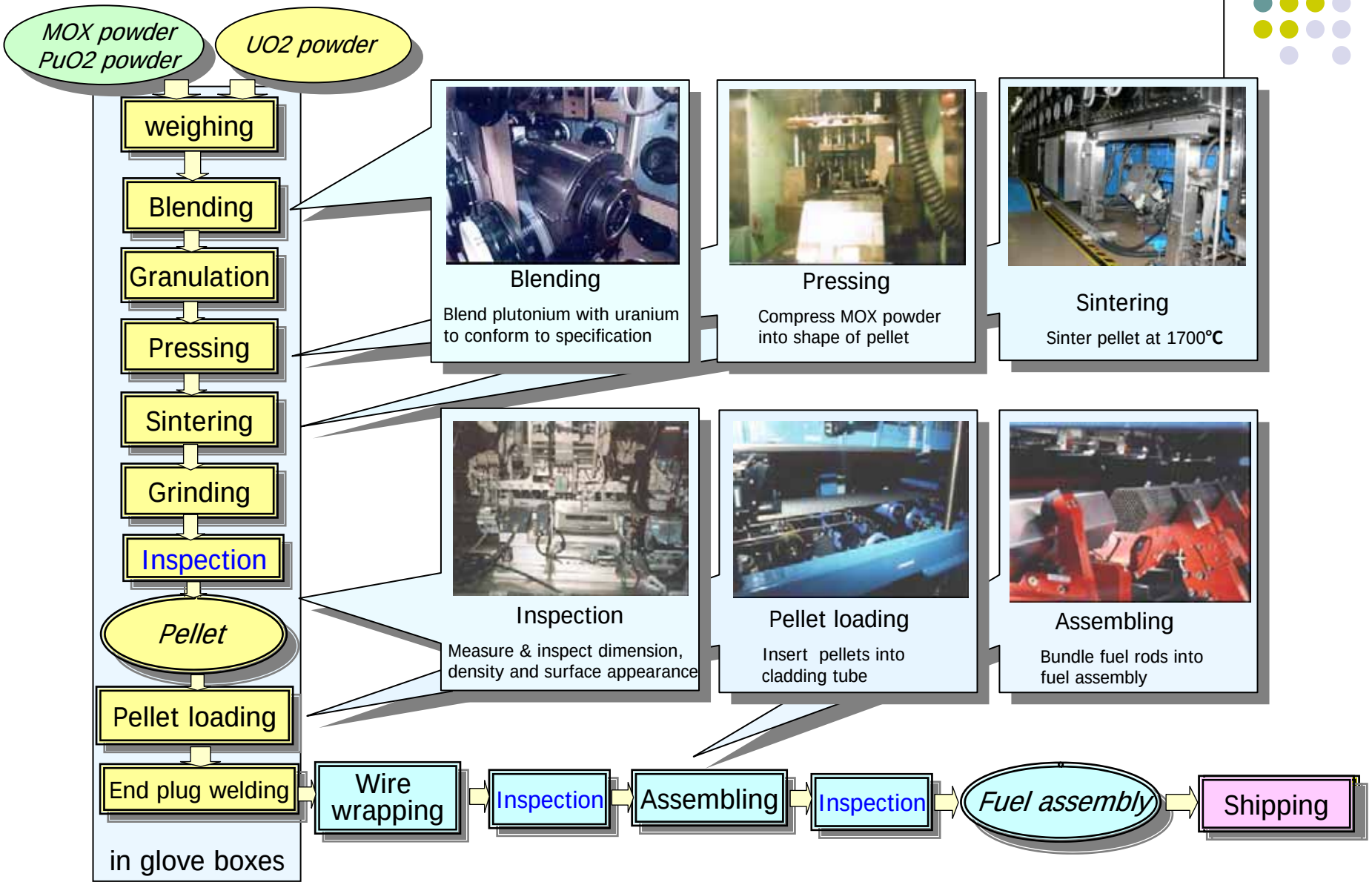
JOYO



MONJU

JOYO	Fuel	MONJU
2,970 mm	Assembly Length	4,200 mm
1,533 mm	Pin Length	2,813 mm
500 mm	Stack Length	930 mm
4.6 mm	Pellet Diameter	5.4 mm
94.0 %TD	Pellet Density	85.0 %TD
20/30wt%	Pu Content	20/30 wt%
18%EU	U Enrichment	DU
127 pins	Bundle	169 pins

Fabrication Process

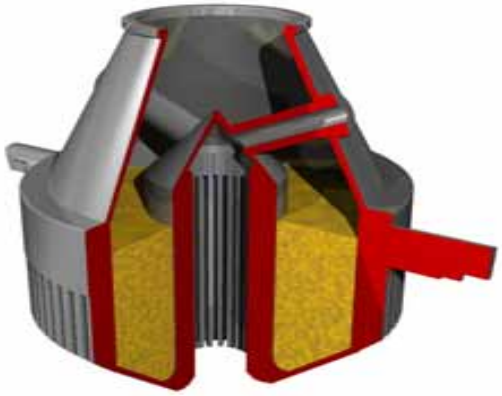


Powder Treatment Process

- Features of Powder Treatment -

- **Blending:**
  - -Ball milling with Al_2O_3 balls and silicon rubber lining
  - -Direct dilution to specified Pu concentration
- **Granulation:**
  - -Rotary pressing into disks followed by crashing
- **Pressing:**
  - -Hydraulic reciprocal machine with 6 punches
- **Transfer Container:**
  - -Special design container with radiation fins
- **Dust Collecting:**
  - -Cyclone system to reduce hold-up material
- **Scrap Recycling**
  - -Jet milling

Al_2O_3 balls & Si rubber lining

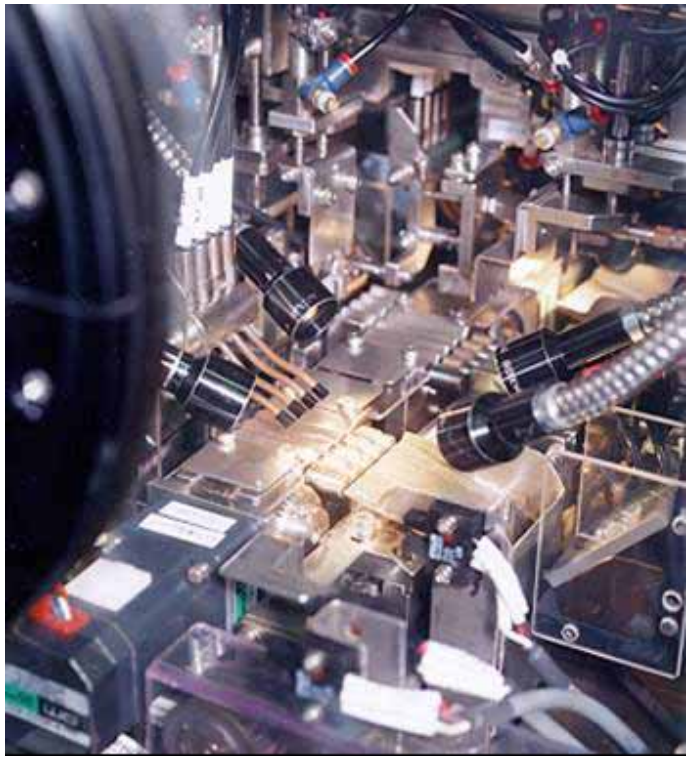


Transfer Container

Pellet Finishing Process

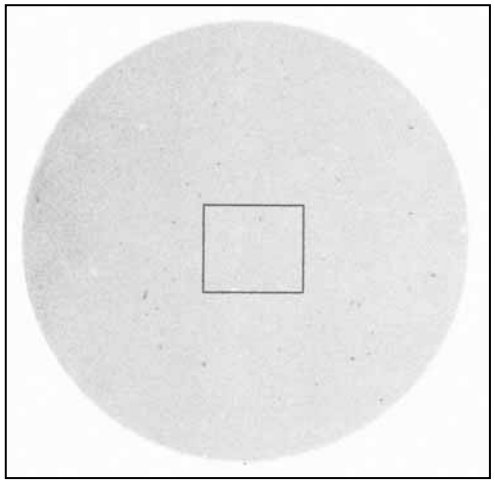
- Features of Pellet Finishing -

- **Sintering:**
  - -Continuous type furnace with maintenance capability
  - -Batch type furnace
  - -Multi function furnace
- **Grinding:**
  - -Dry type system with N_2-gas cooling
- **Inspection:**
  - -Remotely controlled visual inspection
  - -Automated dimension and density inspection

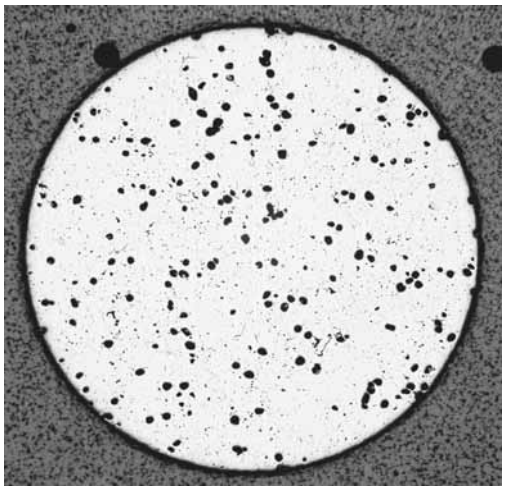


Automatic Pellet Inspection

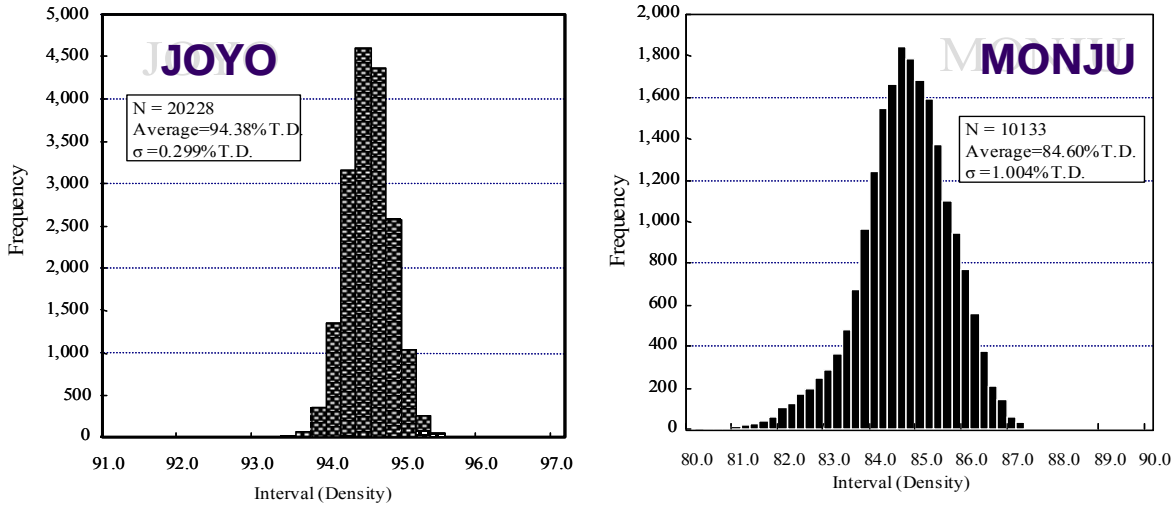
Product Quality



Homogeneity of Plutonium

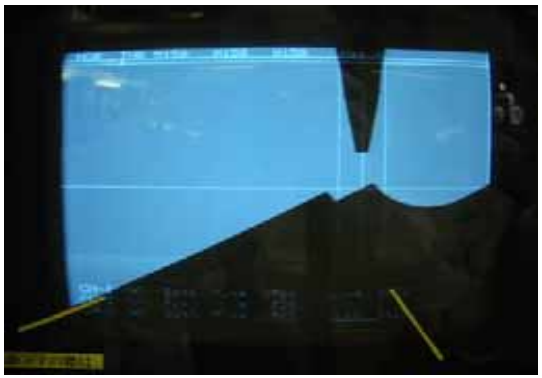


Ceramograph



Density Distribution

Fuel Assembling Process



Automated positioning welding system

Stacker crane type automated intermediate pin storage

Each fabrication station is connected by fully automated fuel pins transferring conveyer system

Remotely controlled assembly transferring and assembly storage

Material Accounting and Safeguards

SBAS
(Super Glove Box Assay System)

WDAS
(Waste Drum Assay System)

Advanced Accountancy System

Near Real Time Accountancy System
Non Destructive Assay System

Receipt

Feed Storage → Process → Product Storage

Shipment

Containment / Surveillance System
Non Destructive Assay System

PCAS
(Plutonium Canister Assay System)

MAGB
(Material Accountancy Glove Box Assay System)

FAAS
(Fuel Assembly Assay System)

“Short Process” / New MOX Pellet Fabrication Process under Development

- Based on Micro-wave Heating method
- Pu/HM content is adjusted before conversion process
- Flowable MOX powder prepared by conversion process
- No additive (binder, lubricant,), no powder processing needed

- Significant improvements in economy, dose, waste,
- Applicable to MA containing fuel fabrication