



# ***FUEL BUNDLE DISMANTLING MACHINE***

## ***PLACIDE***

F.BERDOULA, J.FURLAN, L.CARAL, C.CHAMBION

Nuclear Reactor Division - DEC/SECI/LIGNE

French Atomic Energy Commission - CEA Cadarache - France



## Contents

- Motivations and objectives
- Placide description :
  - scheme
  - main characteristics
- Special features and removable apparatus :
  - Minimum cutting width of 0,5 mm and Eddy current location
- Current activities include NDE : Dimensional measurements & Gamma-spectrometry  
*non destructif exam.*
- Conclusion & Prospects

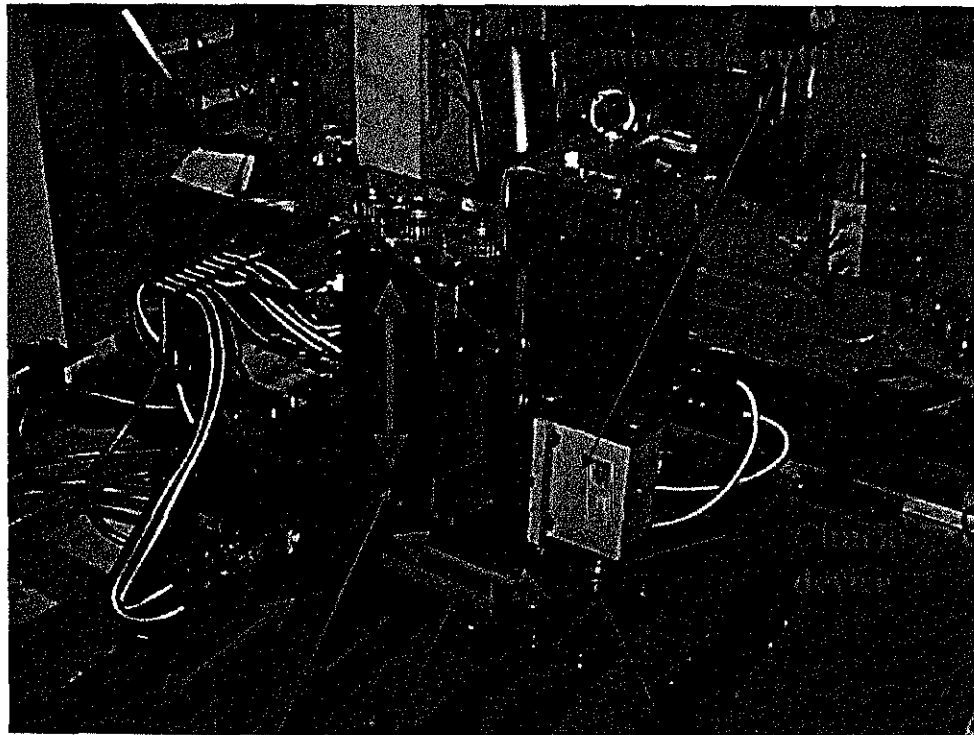


## Motivations and objectives

- The numerically controlled miller **PLACIDE** is designed to disassemble a fuel bundle in **LECA** (Laboratoire d'Examen des Combustibles Actifs, in Cadarache).
- Designed by **LIGNE** (Laboratoire d'ingénierie des expérimentations) of **SECI/DEC** (Département d'Etudes des Combustibles à l'Énergie Atomique).
- Developed, implemented in hot cells in early August 2000.
- Technical characteristics :High-precision machining,
- Specific cutting techniques :minimum width of cutting and location by Eddy current system,
- NDE : Dimensional measurements and gamma-spectrometry,
- Over the year, evolution to other applications.



## Placide description (1)



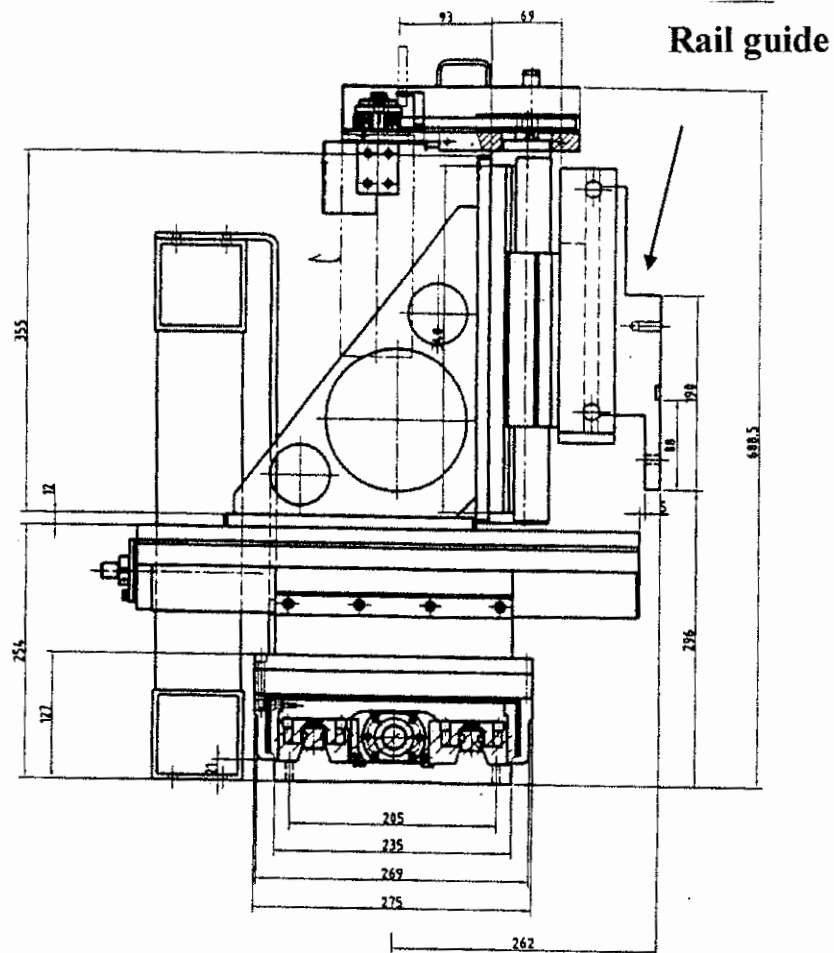
Spindle

Linear guides

- Numerically controlled miller (and 3-axes machining),
- Creepfeed,
- remote handling equipment (motors, electric plug ) in hot cells
- Removeable cutting head,
- Clamp-holding mandrels,
- Purpose-designed tooling : coated solid carbide tools
- Hard and dry machining,
- flat or cross drilling operations,



## Placide description (2)



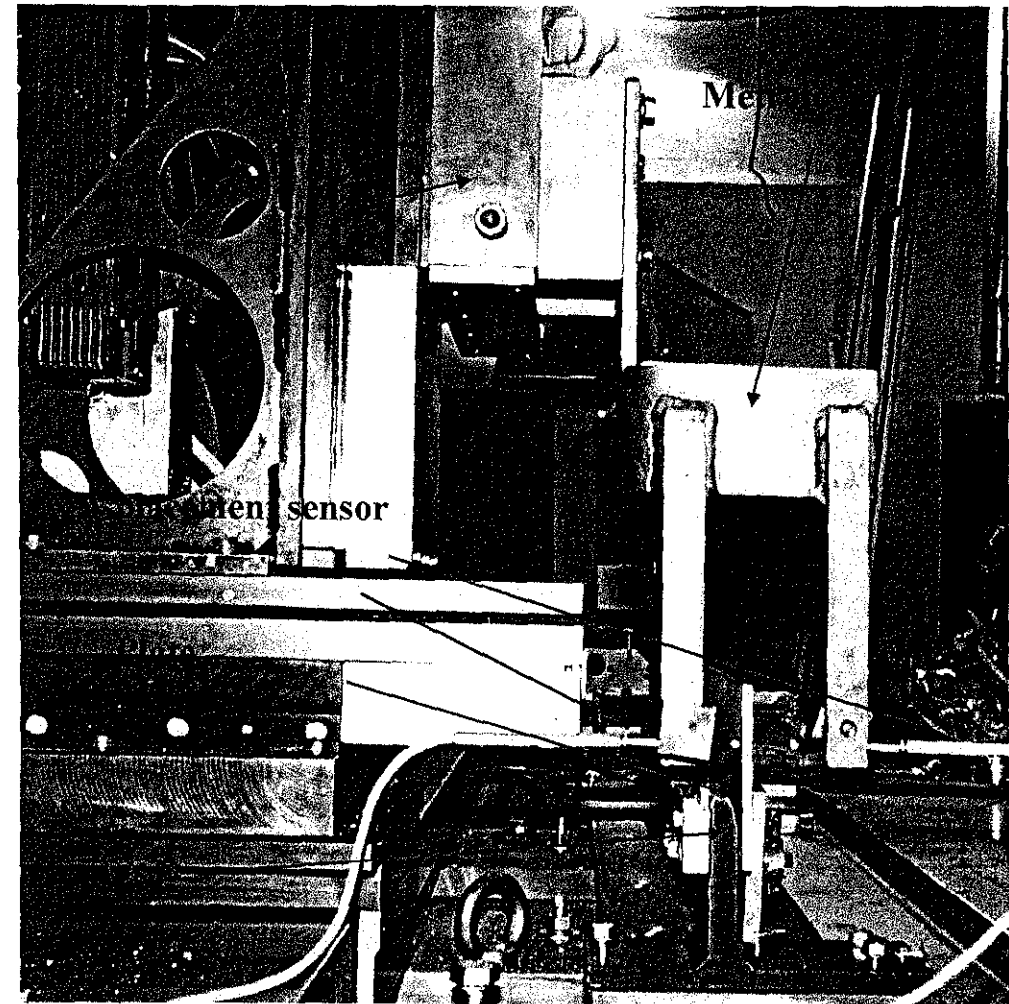
- Complementary apparatus :
- Minimum width of cutting and location by Eddy current systems,
- NDE (dimensional measurements and gamma-spectrometry)
- Visual monitoring by a pool-side periscope and onboard TV cameras





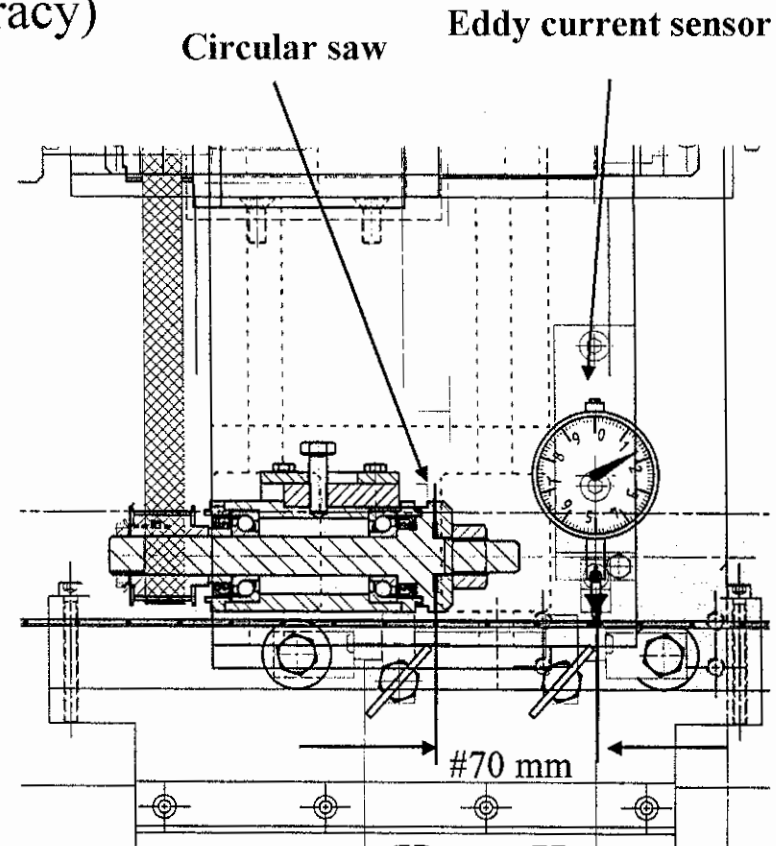
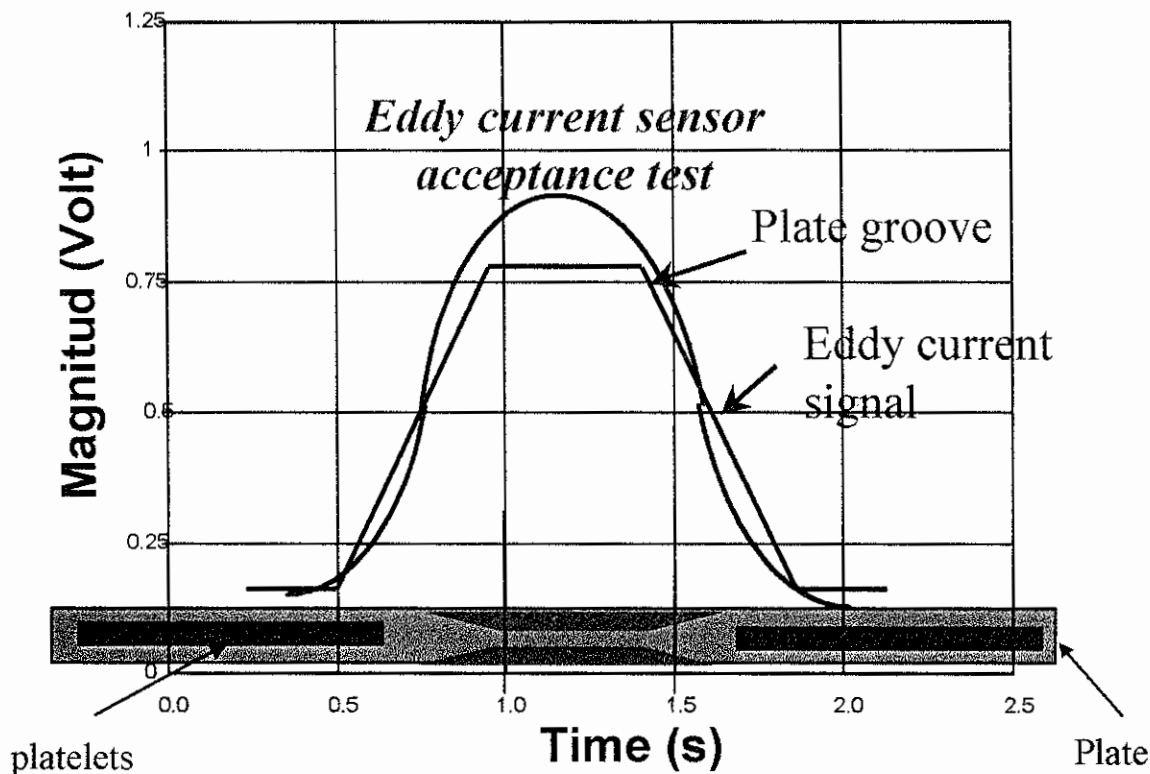
## Metrology system

- A computer monitored metrology system able to measure length, diameter, width of any object (rods, plate...)
- Developed with a cold mock-up



## Eddy Current validation : test on fuel plate type « caramel » developed by the CEA

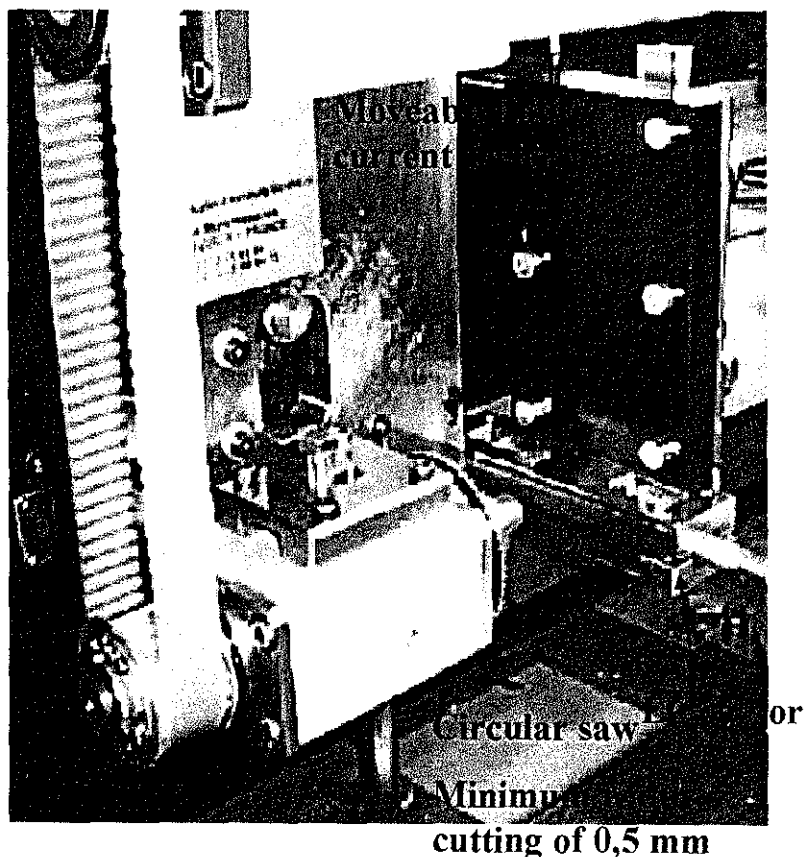
- Test on a « caramel » fuel element :
  - location measurement (better than 0,1 mm accuracy)
  - Frequency range ( from 7 up to 100 kHz)







## High-precision machining and Eddy current location



- These technics, although requiring complex operations in a **hot cell** with specially adapted equipment and a very experienced personnel, enables :
- (1) high-precision machining (better than 0,1 mm)
- (2) a good reproducibility of the Eddy current signals was observed (location accuracy better than 0.05 mm)



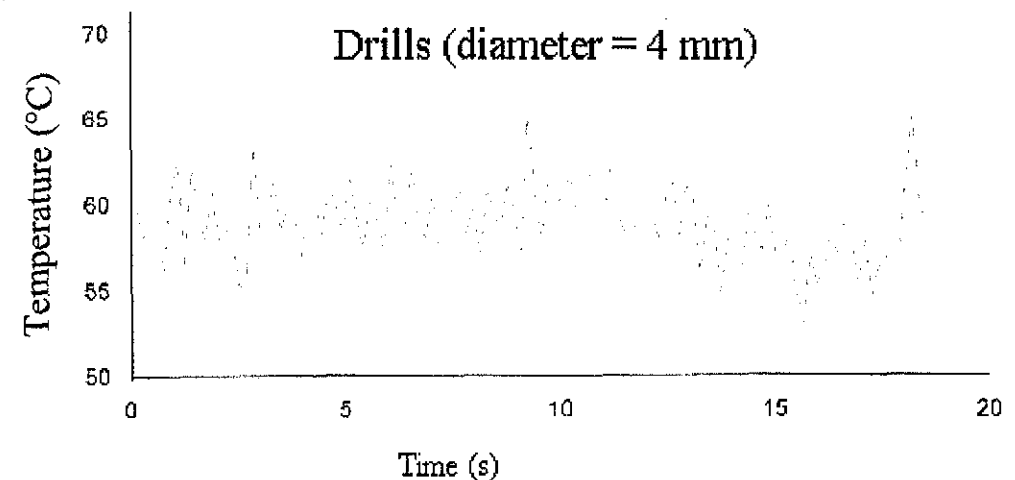
## Machining parameters

### -Aim :

- to adapt machining parameters for Zircaloy and increase tool life (minimize tool exchange)
- to monitor the temperature of the cutting tool during machining operations (minimize metal heating)

### - Observations and conclusions:

- Cooling of chip is extremely fast (1/10 s)
- Results : Temperature of drills < 100°C
- Vacuum-cleaner is necessary (cooling and chips and dust recovery)





## Conclusion

- Multi-functions milling device,
- Creepfeed,
- High-precision machining and location,
- NDE,
- Upgrade to new cutting devices as Removable Bandsaw machine