

ciemat

***CURRENT STATUS OF CIEMAT FACILITIES
FOR RADIOACTIVE MATERIALS***

Jesús Lapeña, Dolores Gómez-Briceño, Francisco Perosanz

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ORGANIZATION

MANAGING DIRECTOR

**GENERAL SECRETARY
FOR EXTERNAL
RELATIONS**

**COMMERCIAL
MANAGEMENT**

HUMAN RESOURCES

**ECONOMIC CONTROL AND
SERVICES**

**NUCLEAR
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**FUSION &
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PARTICLES
DEPARTMENT**

**FOSSIL FUEL
DEPARTMENT**

**ENVIRONMENTAL
ENERGY IMPACT
DEPARTMENT**

**RENEWABLE
ENERGIES
DEPARTMENT**

NUCLEAR FISSION DEPARTMENT

ADMINISTRATIVE SUPPORT DEPARTMENT

STRUCTURAL MATERIAL PROGRAM

- Effects of Irradiation in the Structural Materials
- Corrosion of Materials in Nuclear Power Plants
- Behaviour of Metallic Materials in Energetic Plants

SAFETY TECHNOLOGY PROGRAM

- Severe Accidents
- Diagnostic Technology

RADIOACTIVE WASTE TECHNOLOGY PROGRAM

- Characterization of Radioactive Material and Waste
- R & D on Low and Medium Level Radioactive Waste
- R& D on High Level Radioactive Waste
- Management of Radioactive Waste
- Follow-up of CIEMAT-ENRESA agreement on Radioactive Facilities



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MATERIALS PROGRAMME

RESEARCH & DEVELOPMENT ACTIVITIES

- **EFFECTS OF IRRADIATION ON STRUCTURAL MATERIALS**
 - ***Vessel Steel Embrittlement***
 - ***Testing of Surveillance Capsules***
 - ***Low Activation Materials for Fusion***
- **MATERIAL COOLANT INTERACTION**
 - ***Stress Corrosion Cracking in BWR***
 - ***Steam Generator Tubes: PWSCC, IGA/SCC...***
 - ***Vessel Head Penetrations***
 - ***Irradiation Assisted Stress Corrosion Cracking***

MATERIALS PROGRAMME

LIFE EXTENSION ACTIVITIES

ENM

■ **IMPROVED SURVEILLANCE PROGRAM**

- ***Participation in CRP (IAEA) on “Assuring structural integrity of reactor pressure vessels”***
- ***Subsized sample studies in cooperation with Polytechnic University of Madrid***
- ***Welding reconstitution techniques***
 - *Stud Welding*
 - *Electron Beam*
- ***Evaluation of Fracture Toughness (K_{IC}) using dynamic test***



SPANISH NUCLEAR UNITS

| Plant | Capacity (MWe) | Supplier | Type | Firsts Operation |
|--------------------------|----------------|------------------|------|------------------|
| Cabrera | 160 | Westinghouse | PWR | 1968 |
| La M ^a Garoña | 460 | General Electric | BWR | 1971 |
| Almaraz I | 930 | Westinghouse | PWR | 1981 |
| Almaraz II | 930 | Westinghouse | PWR | 1983 |
| Ascó I | 930 | Westinghouse | PWR | 1983 |
| Ascó II | 930 | Westinghouse | PWR | 1985 |
| Cofrentes | 990 | General Electric | BWR | 1984 |
| Trillo | 1041 | KWU | PWR | 1988 |
| Vandellós II | 992 | Westinghouse | PWR | 1988 |

- **Microscopy**
- **Surface Analysis**
- **Semi Hot Cells**
 - *Mechanical Testing*
 - *IASCC Testing Loop*
- **Hot Cells**
 - *Mechanical Testing*
 - *Optical Microscopy*
 - *Mechanization*

■ **Microscopy**

- SEM/EDS
 - HITACHI 30 kV
 - 35 Å resolution
 - KEVEX EDS System
- TEM/EDS
 - JEOL/JEM 2010
 - 200 kV
 - LINK EDS detector with ultrathin window for microanalysis



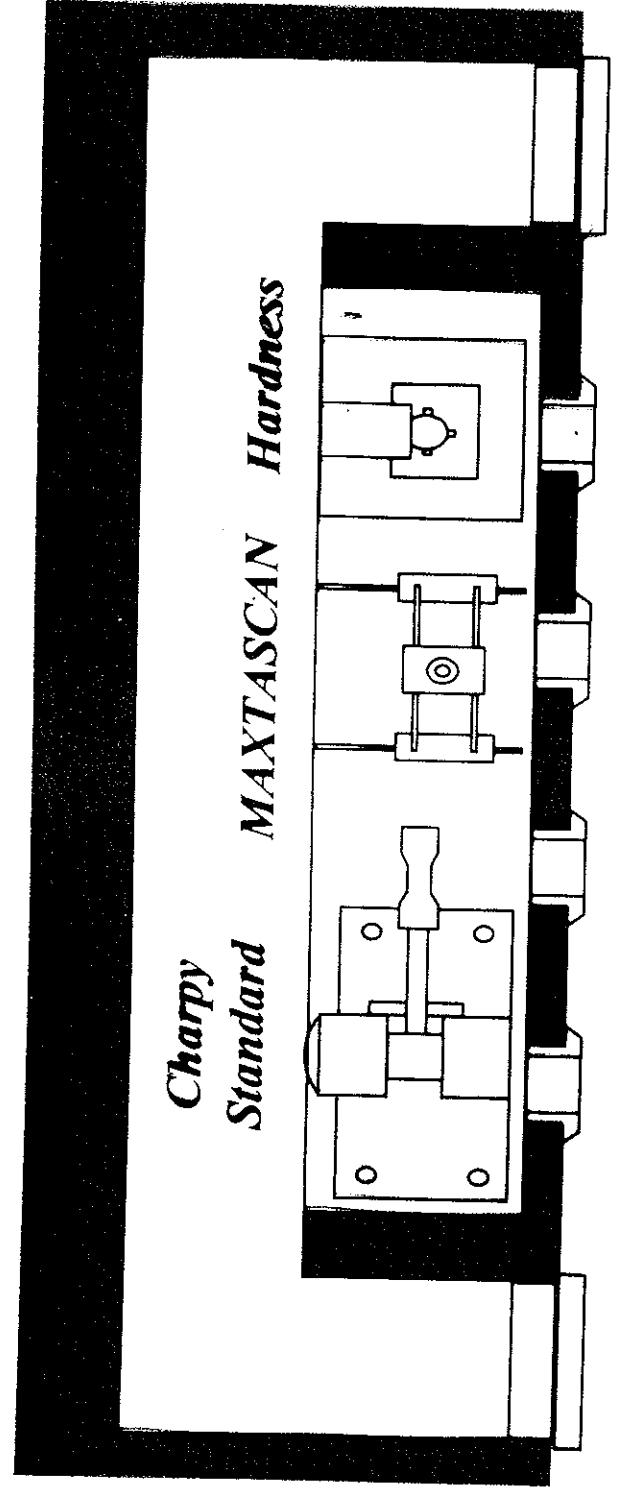
Surface analysis

- AUGER
 - PHI 660
 - Fracture by impact
 - Fracture by tension (Minimum extension rate 1 $\mu\text{m/s}$)
- ESCA
 - PHI 5400
 - Lens system to analyze an area as small as 200 μm^2



MATERIALS PROGRAMME
RADIOACTIVE FACILITIES

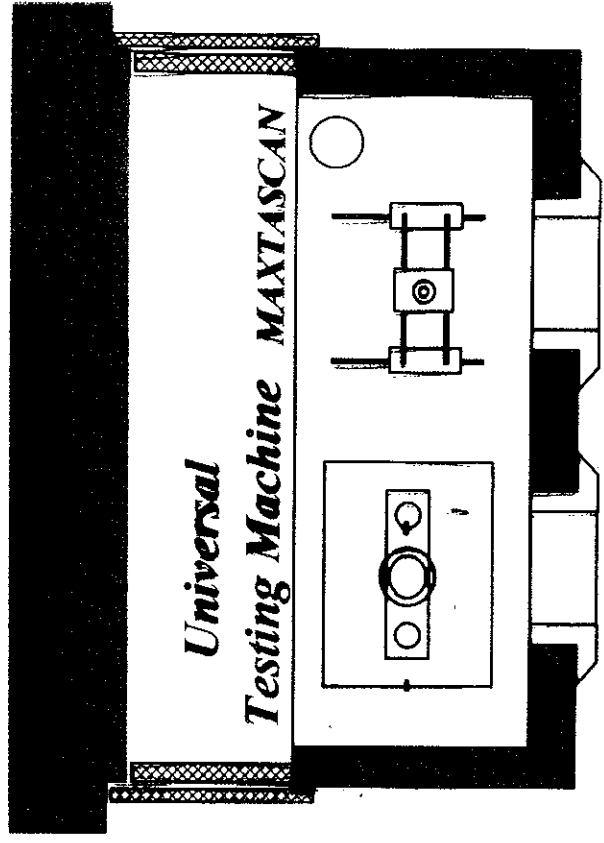
- **Semi Hot Cells**
- **Charpy 300 J;**
 - T Range: -70°C 200 °C
- **Hardness**
 - *Vickers (Hv 10, Hv 30)*



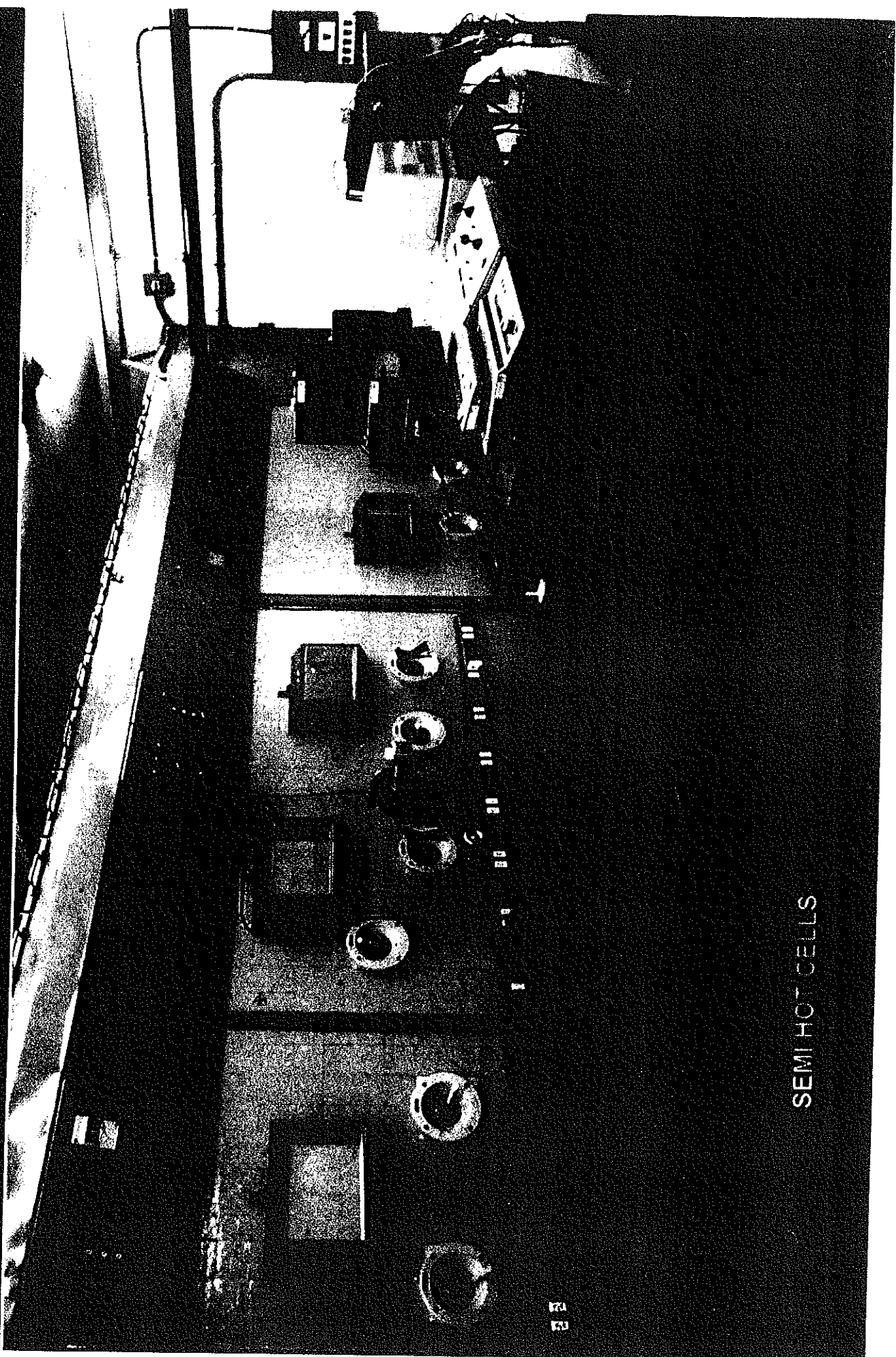
■ **Semi Hot Cells**

Servo-hydraulic Testing System (MTS 810, 100 kN)

- **Tension**
 - T range: -100°C 700 °C
- **Fracture Toughness**
 - CT (1 & 1/2 ")
 - Three Point Bend
 - T range: -100 °C 150 °C



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SEMI HOT CELLS

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WATERLUS PROGRAMME

LIFE EXTENSION ACTIVITIES



IASCC ACTIVITIES

Participation on International Groups

OCDE Halden Reactor Project

International Cooperative Group on IASCC

Cooperative IASCC Research (CIR) Programme

As Technical Representative of Spanish Utilities

MATERIALS PROGRAMME

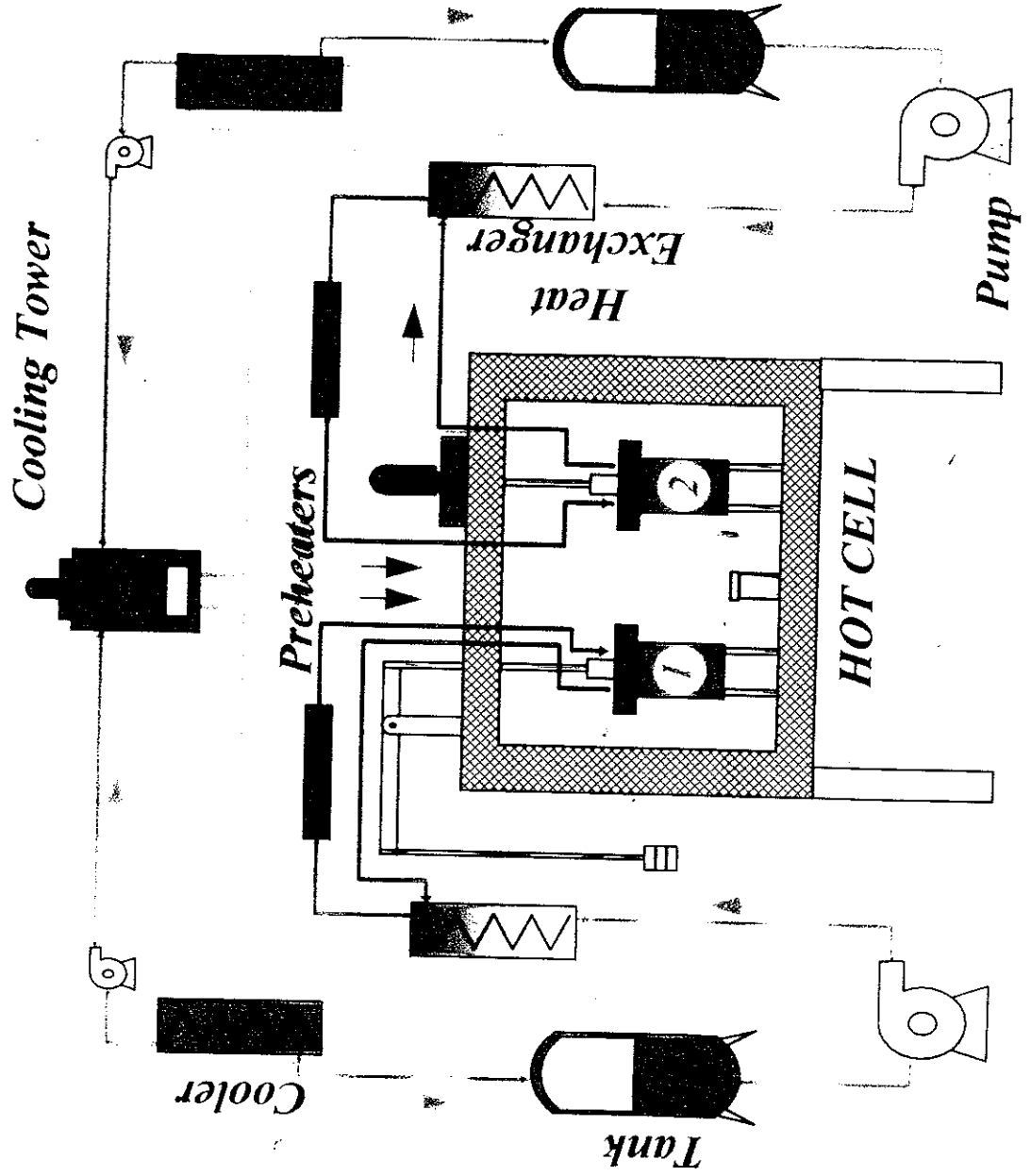
LIFE EXTENSION ACTIVITIES



■ IASCC ACTIVITIES

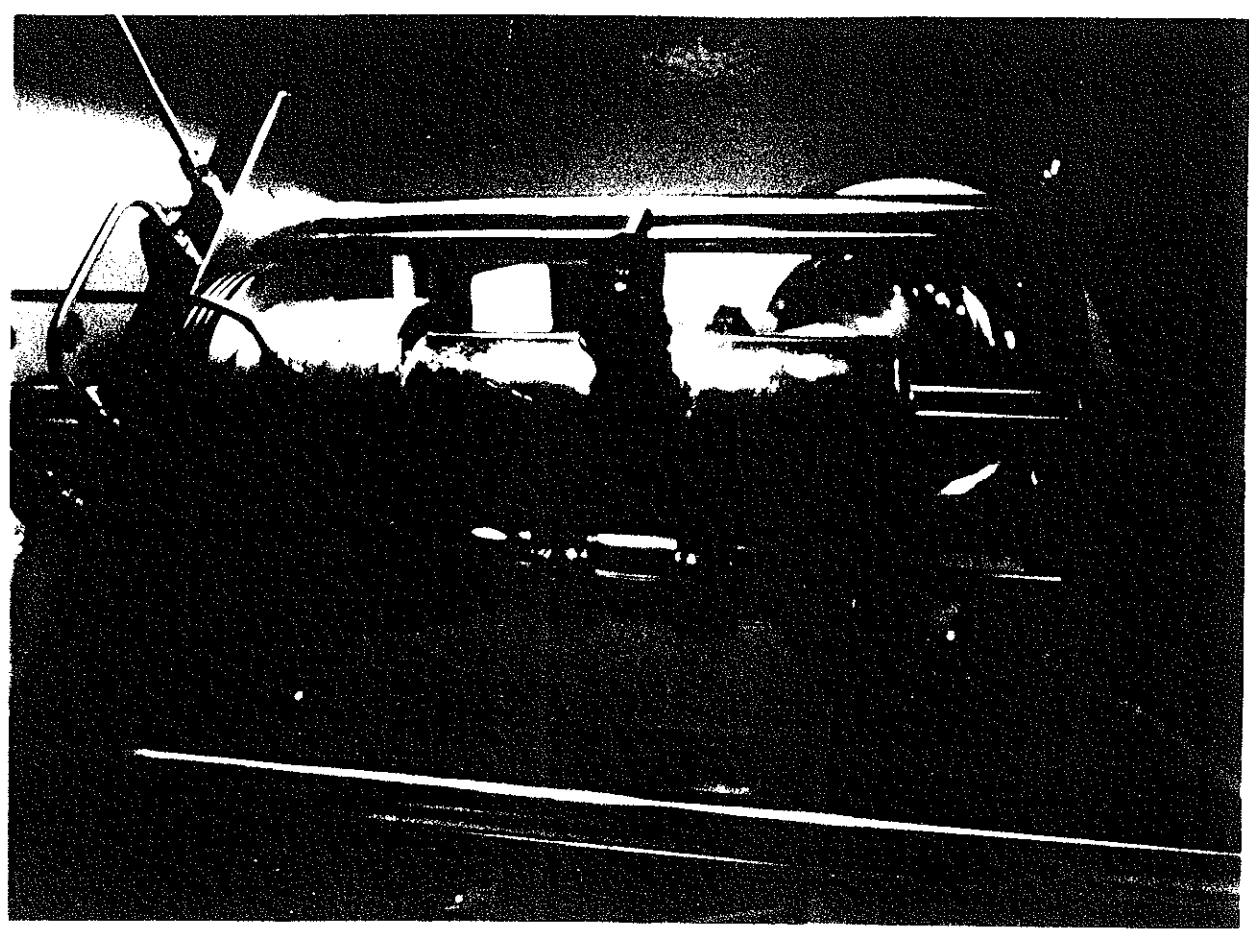
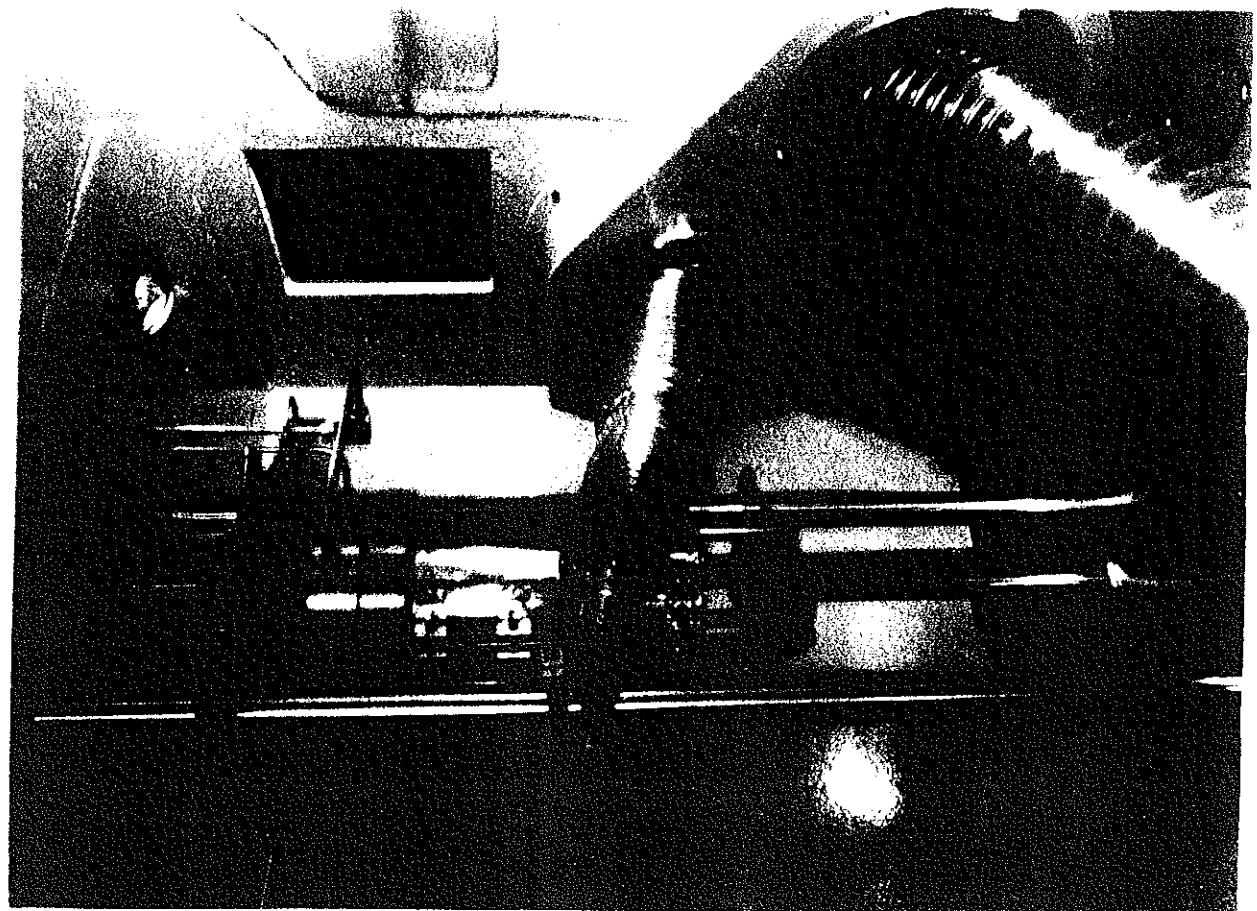
- **Experimental Programme:**
 - *Proton irradiation as alternative to neutron irradiation in cooperation with University of Michigan*
 - Microstructure and Microchemical studies
 - Corrosion tests
 - *Testing of neutron irradiated materials from Spanish Plants*

IASCC



- BWR or DWR
 - Conditions
 - 2 autoclaves
 - Constant Load 1
 - CERT 2
- (Disp. rate > 1µm/h)

CERT & CL AUTOCLAVES FOR IRRADIATED MATERIALS TESTING



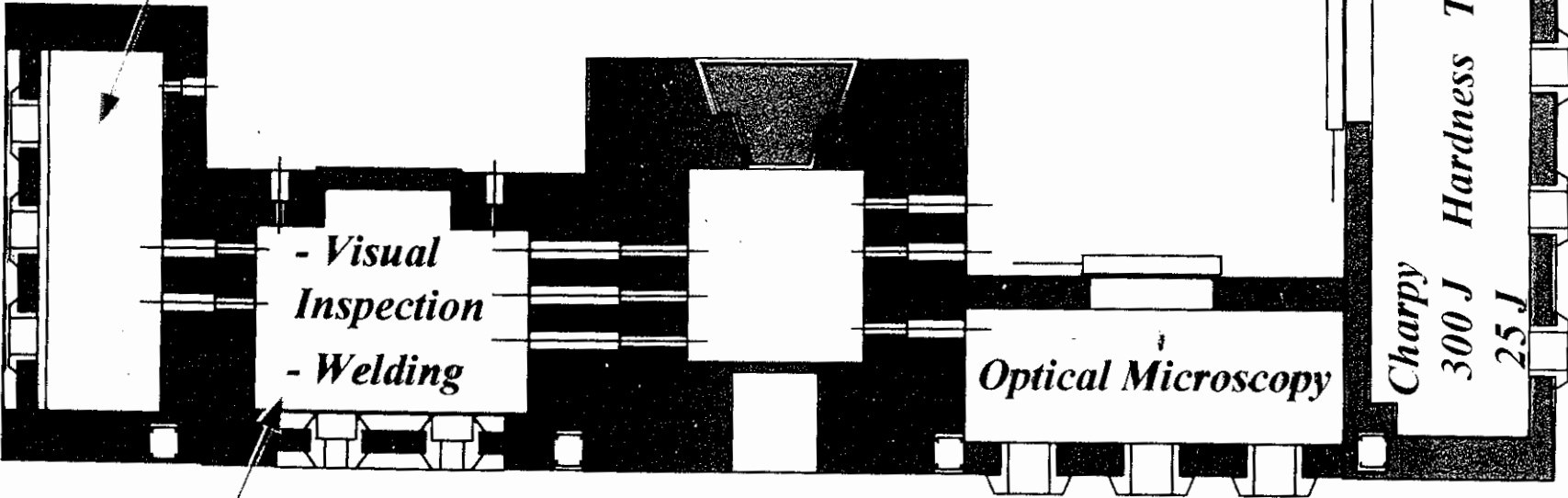
MATERIALS PROGRAMME

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HOT CELLS

- Concrete Shielding
- Lead Shielding

- *Materials Reception*
- *Cutting Samples*
- *Milling and Drilling*

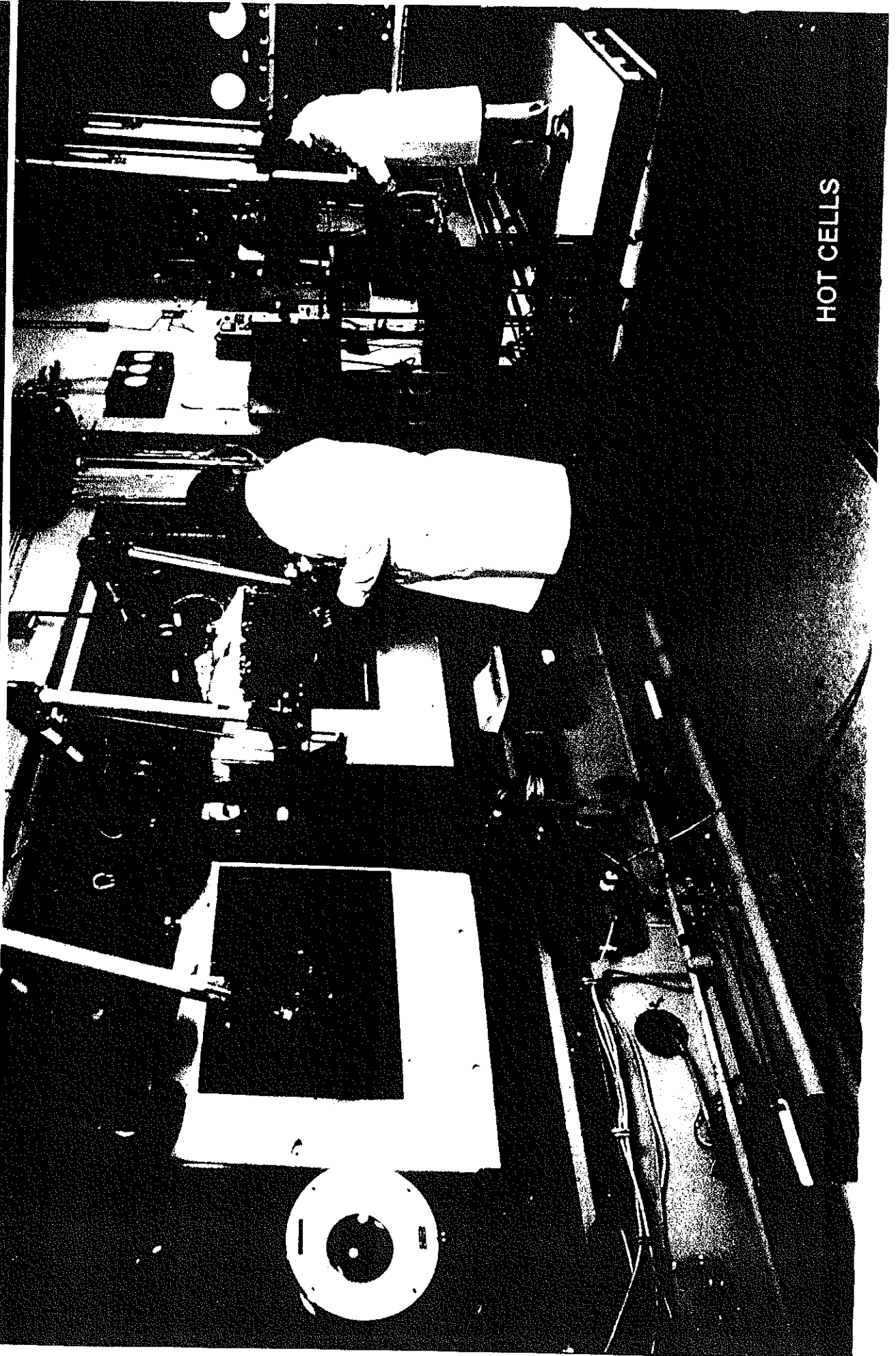


- *Electro discharge*

└ **Hot Cell Facilities**

- **Milling, Cutting and Drilling**
- **Visual Inspection and Dimensional Control**
- **Sample reconstitution by Stud Welding**
- **Mechanical testing**
 - **Tension, Fracture Toughness**
 - **Instrumented impact test (300 and 25J)**
 - **Hardness**

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HOT CELLS