JULES HOROWITZ REACTOR (JHR)

PROPOSAL FOR RESEARCH ACTIVITIES

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Nuclear Measurements and Instrumentation

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RESEARCH ACTIVITIES

1) Irradiated Graphite:
   - Physico-chemical and mechanical characteristics.

2) HTMR:
   - Scaling Factor for ^{55}Fe e ^{63}Ni with integrated neutron flux.

1) Evaluation of the characteristics of irradiated graphite

GCR-MAGNOX Latina, Italy

- Modification of the characteristics of graphite under irradiation:
  - Thermal resistance;
  - Thermal conductivity;
  - Thermal expansion coefficient;
  - Young's modulus;
  - <u>Mechanical strength</u>

- Residual radioactivity in the graphite:

  ^{14}C,^{3}H, ^{60}Co, ^{94}Nb, ^{162}Eu, ^{154}Eu

- Activation of impurities in stainless steel wires for assembly of graphite bricks.

- Fission products from uranium traces.

CONTAMINATION RISK FOR EXPOSED WORKERS

1) EVALUATION OF THE CHARACTERISTICS OF IRRADIATED GRAPHITE

Experimental tests

- Introduction in core of samples of different kinds of pure graphite, lacking air in order to avoid ^{13}N activation.

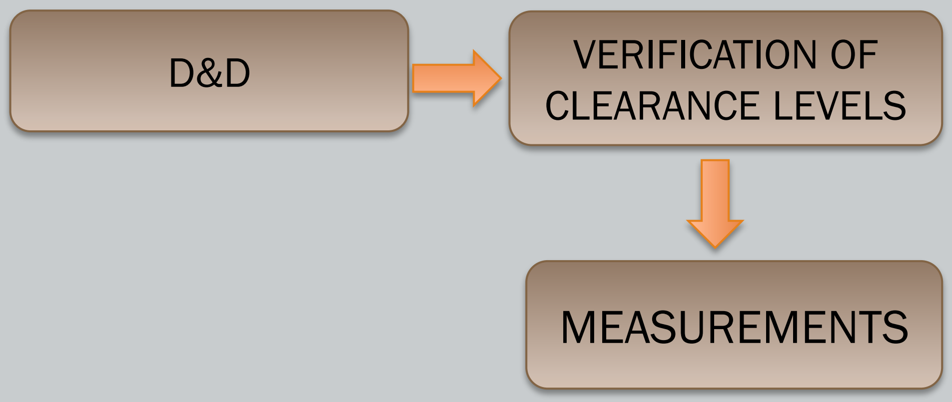
- Reaching the same irradiation conditions of the graphite at MAGNOX NPP, Latina
  - Operating time MAGNOX Latina : 23 years.
  - For a neutron flux of ~10^{15} n/cm^{2}s one week of irradiation is needed.

- Mechanical tests on irradiated samples and evaluation of the characteristics of the irradiated graphite.

- Based on the results obtained, adoption of the most suitable operations for removing the irradiated graphite (moderator) from the core.

2) HTMR: HARD TO MEASURE RADIONUCLIDES

DECOMMISSIONING



HTMR: Radionuclides that decay without emission of detectable gamma radiation.

(beta, Auger electrons, α-emitters, X-rays, low energy γ rays)

MAIN HTMR IN NUCLEAR PLANTS

HTMR	T ½ [y]	Decay mode	Origin	Measuring technique
^{55}Fe	2,73	EC	Activation of ^{54}Fe, ^{56}Fe	LSC
^{63}Ni	100	β^-	Activation of ^{62}Ni,^{63}Cu	LCS, AMS
Both present in irradiated steel				

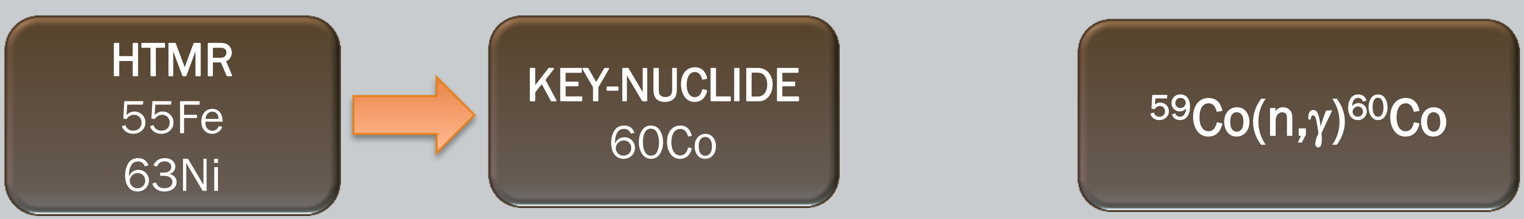
LSC: Liquid Scintillation Counting; AMS: Accelerator Mass Spectrometry

2) HTMR-SCALING FACTOR METHOD

- Indirect mathematical method based on the possible relationship between the specific activity of two nuclides.
- Main assumptions:
  - Both radionuclides must come from the same waste stream.
  - The ratio between the specific activities *a* of the nuclides remains constant.
  - The Key-Nuclide must have the same origin as the involved HTMRs (i.e., activation)

$$SF(A/B) = \frac{a(A)}{a(B)}$$

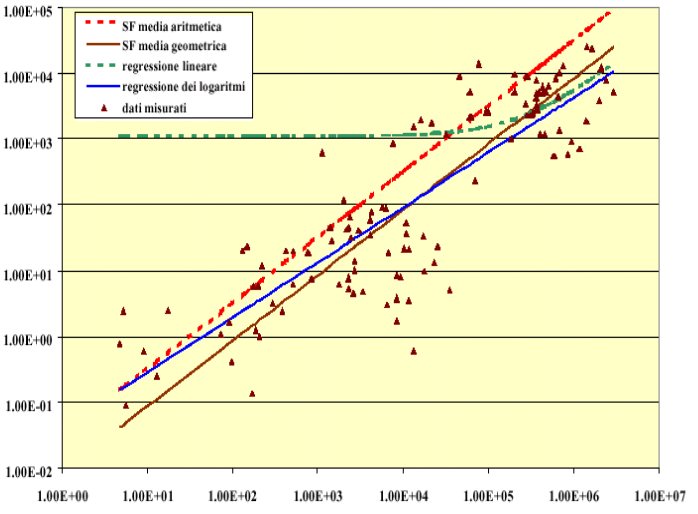
- If SF is known, the abundance of the HTMR can be determined from quantification of the **Key-Nuclide**.



2) HTMR-SCALING FACTOR METHOD

AIM: define a relation for the determination of the *scaling factor* for different values of the integrated neutron flux

- Introduction of samples in core: samples of different kinds of steel used in nuclear reactors.
- Measurements of the abundance of the involved radionuclides (HTMR+Key-Nuclide) in the irradiated sample.



- Definition of graphs and mathematical relations for SF as a function of the integrated neutron flux.
- Applications during decommissioning:
  - Evaluation of the abundance of ^{55}Fe e ^{63}Ni;
  - Appropriate actions for a safe management of metallic materials.