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PROGRESS ON RERTR ACTIVITIES IN ARGENTINA

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ABSTRACT

During 2005 CNEA has continued and developed new RERTR activities. Main goals are the plan to convert our RA-6 reactor from HEU to a new LEU core, to get a comprehensive understanding of U-Mo/Al compounds phase formation in dispersed and monolithic fuels, to develop possible solutions to VHD dispersed and monolithic fuels technical problems, to optimize techniques to recover U from silicide scrap samples as cold test for radiowaste separation for final conditioning of silicide spent fuels. and to improve the diffusion of LEU target and radiochemical technology for radioisotope production. Future plans include

- Completion during 2006 the RA-6 reactor conversion to LEU
- Improvement on fuel development and production facilities to implement new technologies, including NDT techniques to assess bonding quality.
- Irradiation of miniplates and full scale fuel assembly at RA-3 and plans to perform irradiation on higher power and temperature regime reactors
- Optimization of LEU target and radiochemical techniques for radioisotope production.

1. Introduction

During 2005 RERTR R&D activities in CNEA were focused on

- the decision to convert the RA-6 reactor from its HEU core to a new LEU one,
- to get a deeper and comprehensive understanding of U-Mo/Al alloys interaction zone formation in dispersed fuels,
- to develop promissory solutions to VHD monolithic and dispersed fuels technical problems,
- to optimize cold test for radiowaste separation for final conditioning of silicide spent fuels by recovering U from silicide fabrication scrap samples
- to improve the diffusion of LEU target and radiochemical technology for radioisotope production.

2. RA-6 conversion

It is a pool-type 0.5MW reactor sited in Bariloche Atomic Center, Provincia de Rio Negro. At present and since its inauguration in1983 it is working with a HEU core. The conversion project and the adhesion to the SNFFRR Acceptance Program is the result of an agreement between US NNSA DOE and CNEA. Respective contracts have just been signed. The project covers different tasks:

- Argentina as a partner of the GTR Initiative has decided to minimize the HEU inventory through a swapping operation of HEU (Arg)-LEU (USA) materials and down blending in CNEA other inventories
- Fuel design and U3Si2 fuel based fabrication of new LEU core
- Removal of HEU core and condition for transportation
- Cask loading and transportation to exportation port

The project is going on schedule and it is foreseen its completion during 2006 austral spring.

3. Very High Density fuel development

An intense activity both on dispersed and monolithic VHD fuels are taking place

- U-Mo based (both dispersion coated and monolithic) miniplates using Zry-4 cladding were produced and sent to INL-USA to be irradiated as a part of RERTR 7 experiment at ATR reactor. A special work will be presented during the technical sessions

CNEA´s MINIPLATES	MZ50/CNEA	MZ25/CNEA	HMDC/CNEA	HMDS/CNEA
Plate thickness [mm]	1,01	0,99	1,45	1,45
Meat thickness [mm]	0,51	0,26	0,64	0,65
Meat width [mm]	18,6	18,8	21,4	21,9
Meat longitude [mm]	71,0	73,0	80,7	87,0
Total U [g]	10,9	5,9	7,50	8,34
Meat density [gU/cm^3]	16,2	16,5	6,8	6,7
Ratio U/surface [gU/cm^2]	0,41	0,21	0,22	0,22
Porosity [%]	-	-	5	7

Table 1: Characteristics of monolithic (left columns) and dispersed coated (right columns) miniplates

- Alternative VHD UZrNb based monolithic development: U, Zr and Nb alloys were studied and developed. The alloys characteristics to retain at low temperature methastable bcc crystalline structure were found. It was possible to produce UZrNb alloy 8g/cc density miniplates using Zry-4 cladding

- FSW bonding techniques: continuing with the development of this technology to weld Al cladding to monolithic meat, through the design of a special thermal regulated bench, it was possible to produce 6 full scale plates. No bending or rippling in final product was observed. Bending tests were satisfactory There is needed the application of non destructive testing (NDT) techniques to assess the bonding quality during production.

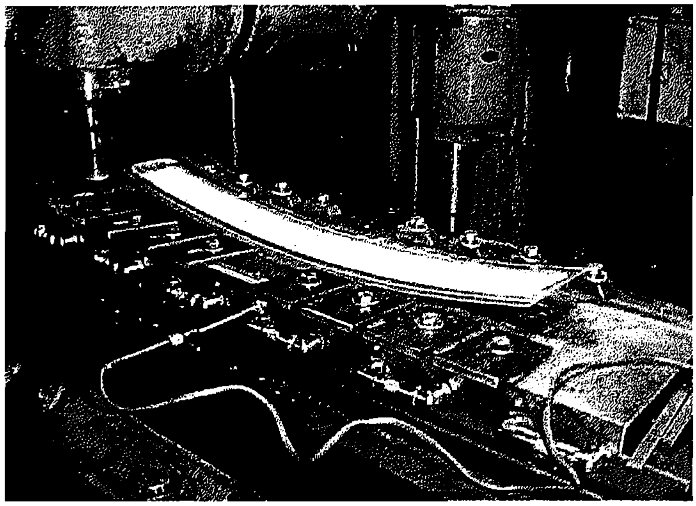

Photo 1: view of upper plate after FSW process.

- An irradiation program at RA-3 reactor is starting. The position for miniplates are the central irradiation box where a thermal neutronic flux of 2e+14 n/cm2/s) is achieved. The program includes the irradiation of diffusion couples to estimate the influence of irradiation on interaction zone growth. Aforementioned VHD prototypes are included in the irradiation program.

4. Characterization of phases in U-Mo/Al alloys interaction zone

- Theoretical calculation using BFS (Bozzolo, Ferrante Smith, 1992) method for determining the atomic system energy as a function of it geometrical configuration were performed. This provides a virtual model of an alloy formation process. This methodology applied to UMo/Al-Si alloys predicts that the presence of Mo inhibits but does not avoid the Al diffusion and the tendency to compound formation. Mo-Si interaction inhibits Si diffusion. Also predicts Si atoms migration from Al alloys to interaction zone, the diffusion of Si in U if Mo is not present and Si inhibits Al diffusion only in presence of Mo. This methodology suggest the formation of a phase of the type (U-Mo)-$(Al,Si)_3$.

- Experimental studies of interdiffusion between UMo/Al-Si alloys, at 340 °C, were continued this year to identify the phases in the reaction layer. Data for new temperatures were added to the TTT diagram U-7wt%Mo, and U-7wt%Mo-0.9wt%Pt. Aforementioned theoretical calculation and simulation were performed to predict phase stability. Main result is that the reaction layer at 340 °C is monophasic, and contains approximately.55 at% of Si. The structure is considered to be (U,Mo)-$(Al,Si)_3$ A special work will be presented during technical sessions

5. Cold test for silicide SNF final conditioning

- Silicide production scrap recovery:: by means of a centrifugal device separation of Si from the stream of dissolved products were successfully performed. This is an important step to have available a process to separate actinides and radiowastes from spent fuels for final conditioning.

6. **LEU technology for radioisotope production:**

- a study on radionuclide purity was made on 46 LEU and 28 HEU batches of fission Mo-99 produced in CNEA between 2002 (HEU) and 2003 (LEU) were compared. A general improvement in the radionuclide purity after the change from HEU to LEU targets has been observed. The conclusions are that it is feasible to produce fission Mo99 from LEU targets to obtain a product that complies with the international requirements in accordance with specifications established in the most important Pharmacopoeias. Finally, the potential future positioning of LEU targets into the market, for fission Mo-99 production, should be based on economical or political factors and not in quality consideration A special work will be presented during technical sessions.

AVERAGE VALUES	I-131	Ru-103	Sb-125	Cs-137	Sr-90	Gross Alpha
HEU (# = 28)	2.41E-06	2.77E-07	7.50E-09	2.95E-10	6.88E-09	1.95E-11
LEU (# = 46)	1.50E-07	1.67E-08	5.68E-10	3.62E-10	7.88E-10	1.21E-11
SPECS	< 5,0E-05	< 5,0E-05	< 6,0E-08	< 6,0E-08	< 5,0E-07	

Table 2: Radionuclide purity comparison

- LEU foils for Mo-99 production: CNEA continue working in collaboration with US DoE in the irradiation of uranium foils and testing alkaline dissolution
- IAEA Coordinated Research Project on developing techniques for small scale indigenous Molybdenum-99 production using Low Enriched Uranium (LEU): CNEA is participating as agreement holder
- Sale of CNEA's LEU target technology to Australia's ANSTO and Egypt's EAEA.
- Development of a method for the recovery of the HEU contained in the filters and the separation of Sr-90 for the use in Y-90 generators

7. Conclusions

CNEA is deploying an intensive activity on R&D on RERTR technologies. Concerning VHD fuels, we focused our work some promissory lines for technological solutions both on dispersed and monolithic fuels. Concerning LEU technologies for radioisotope production we are deeply involved on its development and sale. Future plans includes:

- Completion during 2006 the RA-6 reactor conversion to LEU
- Improvement on fuel development and production facilities to implement new technologies, including NDT techniques to assess bonding quality.
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