2004 STATUS OF RERTR ACTIVITIES OF CNEA - ARGENTINA

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During 2004 several activities related to RERTR topics has taken place. In what follows, a resume of those activities is presented

1.1. VERY HIGH DENSITY FUEL DEVELOPMENT

During 2004 the Nuclear Fuel Cycle Program has supported the activities of about a hundred of researchers and technicians involved on different aspects of VHD fuel development as R&D, miniplates, plates and fuel assemblies fabrication, irradiation and PIE analyses of VHD fuels.

The technological challenges presented by the behavior of materials under irradiation for the development of VHD fuels were and are the main motivation for the participation of an increasing number of professionals and technicians.

Two national meetings on these topics has taken place, the first on April 12th and 13th, the second on September 8th and 9th In both meetings, more than 40 R&D works made by specialists from several technical groups, belonging to Nuclear Fuel, Material and Non Destructive Testing Departments were presented.

The fields of work are:

- Use of first principles atomic modeling, to develop stabilizing coatings or admissible matrix alloys
- Out-of-pile diffusion couples testing (a special work will be presented during technical sessions). Plans for irradiation.
- U-Mo based ternary compound modeling, to find the way to delay U α phase decomposition on grain boundaries
- Development and fabrication of U-Mo powders and sheets (a special work will be presented during technical sessions)
- Experimental development of particle and sheet coatings (a special work will be presented during technical sessions)
- Fuel design
- Hot rolling facility
- Advanced welding techniques, Friction Stirring Welding process. Non-destructive testing for welding assessment.
- Development and testing of new fuels, new matrix alloys and new claddings.
- 3-D modeling of fuel behavior under irradiation (a special work will be presented during technical sessions)
- RA-3 10 MW irradiation plans. PIE facilities plans.

Main improvements were:

- Through atomic modeling and diffusion couples tests, a deeper understanding of fuel-matrix chemical compatibility was reached.

  The diffusion couples experiments were focused on investigating the possible effects of Al alloys on interdiffusion layer formation. Alloys containing Mg and

/or Si as main alloying elements were used. A special work will be presented during technical sessions. Two features must pointed out here:

- The thickness of the interaction is not influenced by the presence of alloys in Al
- The presence of Si introduces changes in the reaction layer components.

The diffusion couples tests have became a fast and cheap way to have in advance valuable information about fuel-matrix / fuel-cladding chemical compatibility on very high density fuels behavior. So it was decided to adopt the following admissibility criterion, regarding in-pile tests:

- Previous to irradiation tests, fuel candidates must undergo diffusion couples tests.
- Those candidates that succeed (a) tests will be irradiated as meat components of miniplates
- Those materials used in miniplates that succeed (b) tests will be irradiated as meat components of full size fuel plates

- Implementation of FSW technique applications

  Qualification of miniplate fabrication. Successful experiments were performed in order to encase UMo foils in Al using FSW technics
- Development of Zry-4 MTR fuel cladding. Co-lamination fuel-cladding plans

1.2. CNEA'S LEU MTR FUEL WASTE DISPOSAL PLANS

The research and production reactor RA-3 is the only one in Argentina that, up to date, consumes fuel elements. At the maximum power of 10 MW its consumption is approximately 23 FE per year.

Therefore, after 20 additional years of operation, the amount accumulated will be approximately 540 spent fuels, taking into account those which are in interim storage at present. This figure is equivalent to approximately 750 of kg heavy metals.

Consequently, the management of the SF from the reactor RA-3 is a question that is receiving close attention in CNEA.

The SF will be kept in interim storage until a geological repository is available for disposal. According to the current planning, this repository would be available in the year 2050 to receive the SF from the NPP´s or the HLW from their reprocessing.

The main stages in the management of the MTR SF will be:

- Interim wet storage

  At present the SF are in wet storage in a subsurface tube-type installation that is going to be replace by a pool-type facility with a capacity for 600 MTR SF.

  The new facility will be ready in the year 2006 and will permit a better control of the water chemistry enhancing the quality of the storage conditions.Conditioning for disposal

  After decay in the storage pool during 10 to 15 years, the SF will be conditioned for disposal and the resulting waste form, properly canned, will be installed in a dry storage system until the geological repository is availability.

  After several years of analysis and basic research on different processes, to move forward in the selection of the most suitable conditioning route, the following criteria were used:

- o Simplify the process flow chart, by discarding the initial step of decladding the fuel plates (previously considered)
  - o Select the most proven chemical processes, by using the wet route, e.g., dissolution of fuel plates with nitric acid.
  - o Minimize the volume of the final high-level waste form; by separating the U from the waste stream, to avoid the addition of depleted U for isotopic dilution.

  A further separation of the Al is also considered, which will then contribute to the make up of the intermediate-level waste stream, instead of being part of the high-level waste. This Al separation is equivalent to the decladding step discarded at the beginning, it will also diminish the volume of the resulting waste form.
- o Interim dry storage
- o Final disposal

1.3. MO^{99} PRODUCTION USING LEU TARGETS: TWO YEARS OF SUCCESS

Since 2002 the domestic production of Mo99 and other fission radioisotopes is performed using LEU targets, fulfilling international technical and quality standards.

Up to present more than 600 targets bearing LEU material have been fabricated irradiated and processed. Very recently CNEA has also become an international supplier of targets for Mo-99 production

2. INTERNATIONAL FRAMEWORK: THE GTR INITIATIVE

The main challenge to nuclear peaceful applications is how to continue and to improve bringing to the society the advantages of nuclear technology in safer and more secure ways. In this sense the recent formulation of the Global Threat Reduction Initiative pursues, among other goals the worldwide conversion of all civilian use reactors to low enrichment uranium before the end of the year 2013 including those of very high neutron flux.

The GTRI has been publicly announced on May 26th, 2004 in this IAEA headquarters.

Recently, the Global Threat Reduction Initiative International Partners' Conference was held also here on September 18th and several speakers have clearly explained its goals and scheduling. During this Conference Dr. J. P. Abriata, President of the Atomic Energy Commission of Argentina has backed and shared the basic goals of the GTR Initiative.

3. HISTORICAL INVOLVEMENT OF ARGENTINA IN THE PEACEFUL APPLICATIONS OF NUCLEAR ENERGY

Such GTR Initiative is –and has been- encompassed by Argentina through many works and joint undertakings, international projects and own developments. Argentina through its state organizations and companies within the nuclear sector has a long tradition in terms of fulfilling:

- Nuclear safety requirements,
- Nuclear security requirements,
- Non-proliferation policies and requirements
- Nuclear material accountability.

The collaboration of fuel groups of CNEA within RERTR goes back to the very beginning of this program. CNEA and the associated enterprises have been involved within the RERTR program for the last 25 years. Main milestones are:

- **International qualification program for LE uranium silicide based fuels**:

participation of CNEA since the beginning of this program

- **LEU MTR type design:**
    - The Peruvian RP-0 facility and RP-10 reactor (1979-1980)
    - The Algerian NUR reactor (1984)
    - The Egyptian ETTR2 reactor (1991)
    - The Australian RRR reactor (2000)
- **LEU MTR core conversions**
    - The Argentinean RA-3 reactor (1989)
    - The Iranian Teheran University reactor (1990), within the frame of an IAEA contract
- **LEU MTR fuel manufacturing**:
    - Uranium oxide based fuel elements:
        - Argentinean RA-3 Reactor (core conversion)
        - Iranian Teheran University reactor (core conversion)
        - Algerian NUR reactor (first cores)
        - Egyptian ETTR2 reactor (first cores)
    - Uranium silicide based fuel elements: CNEA has also qualified as fuel manufacturer
        - At present CNEA fuel fabrication plant is taking the manufacture of 64 fuel elements for the ANSTO Replacement Research Reactor in Australia.

As a result of the above-mentioned activities about 12000 fuel plates were fabricated and successfully irradiated.

- **International qualification program for VHD based fuels:** since 1997 CNEA is involved on RERTR efforts to qualify U-Mo (dispersion and monolithic) based fuels for core conversion policy. Besides, we are exploring other VHD fuel lines
- **Participation within the Acceptance Program:**
    - Recently CNEA has returned back to USA 207 HEU spent fuels (2000).
    - During the International Associates on GTR Initiative Meeting (September 18, 2004, IAEA VIC, Vienna), the President of the Atomic Energy Commission of Argentina besides other initiatives, he offered, (provided that is available adequate financial assistance), the return of 42 HEU RA-6 fuel elements within the Acceptance Program.
- **LEU targets and chemical process for Mo99 production**: already mentioned

CONCLUSIONS:

CNEA and its associated enterprises therefore already meets the objectives and goals of the GTRI and can contribute with technological expertise and services to these efforts.