

## **Chairman's round table-contribution**

**Sessions 2,3 and 4**

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# General Comments

- The mornings session's quest for more discussion time was fulfilled.....
- .....a lot of lively exchanges took place
- Warm thanks to speakers and to the audience!

# India's Th programme

- Dr Vijayan reminded us the very original « 3 stages strategy » set forward by professor Homi Bhabha since the 50's for India Nuclear Power development
- Indian Thorium programme is very well structured, very goal-minded, applies sound technology\* and is timely driven
  - ❖ \*indian-developed
- Indian Thorium programme is the first, since a long-time that provides full-scale validation
  - ❖ HWR (Unat, Breed. Pu) → SFR (Pu, breed U3) → AHWR (Th+U3)
  - ❖ India masters all steps of the Th cycle
  - ❖ High Temperature Reactor, MSR and ADS under development for future deployment

## UK study

- Dr Rob Arnold presented some projections based on scenario studies for a potential deployment of nuclear power in UK based on U/Pu fuel cycle
- Relies on 3 scenarios
  - No new nuclear plant (not even those currently proposed).
  - Up to 75 GW open cycle around mid-21st Century.
  - Up to 75 GW closed cycle around mid-21st Century.
- Includes a study on Thorium-based MFSR
  - Agreement to findings from Grenoble study (EVOL FP7 project, Elsa Merle)

## A Recommendation

- I believe that **it is prudent to develop an alternative to the U-Pu fuel cycle** for future generations. However, it is not easy to make a case for commercial thorium fuel utilization only on the basis of economics. The uranium fuel prices are still much lower than 100\$/pound or \$220/Kg which is considered as the break-even price for introduction of alternate fuel cycle (fast reactors or thorium cycle)
- **Thorium cycle does provide an efficient platform to burn and transmute Pu-239; in LWRs or fast reactors. The U-233 formed can not be easily used for weapons manufacture, since it has much U-232. Long burn-up operation of Pu-Th fuel could also burn the U-233 formed from thorium, thereby producing additional energy. Such an open fuel cycle could indeed be economically competitive with the open fuel cycle currently employed for LWRs. A "mission" of disposal of accumulated Pu could be justified for Th.**
- In future when fuel cycles are closed, the U-233 made in Pu-Th fuelled LWRs or fast reactors could be extracted and employed for power generation in LWRs. This would require shielded facilities for reprocessing and re-fabrication, which would be expensive, but feasible.
- **Research and pilot-scale developments for the Th cycle will need public financing. If governments assume that responsibility, commercial use could become feasible and desirable**

- CERN's DG made the point with the success story of the Higgs:
  - In order to achieve its goals a community must federate around one single project for which everybody is committed
- As much as the particle and nuclear physics community federated around the LHC
  - our community must unite around MYRRHA, the only well advanced project for which at least partial funding exists.
  - Either we get this project through together, or ADS in general and Th-ADS in particular will be killed
  - Nothing more harmful than a dispersed community

- Dominique Greneche reminded the audience that like any other technology Th-cycle based nuclear energy has also some drawbacks. The warnings contained in Dominique Greneche's engaged talk should be taken seriously into account
- A beautiful lesson of the great advances for the physico-chemistry of molten salts and the potential capabilities of the atomistic modelling to derive molten salt material properties have been shown by Paul Madden
- These R&D progresses will open the door to industrial perspectives such as presented by Kirk Sorensen (Flibe LFTR Strategy development) but one should not underestimate the time needed for a civilian application of nuclear technology

- Luc van Den Durpel from AREVA,
  - delivered good news:
    - AREVA and Solvay (2 large industrial groups with large knowledge on Thorium and Nuclear energy) are interested in Thorium fuel cycle
    - They are investing in a R&D programme and invited the audience for joining them if interested
  - But he also said that AREVA as a nuclear industry involved in the fuel cycle in its strategy:
    - Doesn't want to mix the U/Pu and Th/U cycles
    - The Th/U cycle should be introduced progressively in the present fleet of reactors
    - This is a very long time endeavour (> 100 y)
- Prof. Muammer Kaya, announced the Turkish Gov. decision to embark in nuclear power generation but based on U/Pu fuel cycle whereas the country is the second largest country with Th reserves. Aiming to stimulate awareness of decision makers on Th potential for nuclear power in Turkey and to create **Thorium Research Center /ThoReC**

- Tony Donaldson from Rolls-Royce, presented a review of the advantages and challenges of SMR-Th based reactor for commercial application in a fully neutral approach.
- Dr Jan Uhlir, reported on the Czech National programme in the field of MSR development associated to pyroprocessing of LiF-based fuels:
  - MSR and Pyroprocessing R&D has been for decades a research topic in the Czech(oslovac) Republic
  - Since 2000, a renew for these activities were stimulated with the support of Min. Of Industry and Trade and allow NRI and other Czech partners such as Skoda Nuclear Machinery to be important players in the EC FP5, 6 & 7 projects (ALISIA, MOST, EVOL)
  - Objective: position the Czech programme (Material research, pyroprocessing, tests in LR0 reactor, reactor design) in a larger international framework