

Conclusions and Perspectives

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“Incremental progress and breakthroughs are sought on a wide span of structural materials for fuel claddings, core structures, reactor cooling systems & components (*RPV, IHX, SG...*), power conversion systems (*electricity, H2...*)” (F. Carré)

Materials studies are essential for new reactor systems development (GenIV, transmutation, fusion)

Type of fission systems under development:

- **Fast systems (critical or sub-critical) cooled with Na, HLM or gas**
 - **Thermal systems cooled with gas, SCW**
- Materials studies on LWR still essential (e.g. lifetime extension, design rules, higher BU, etc.)**

Class of materials considered: some highlights

Fast reactors (liquid metal cooled).

Claddings:

- past and present situation: **advanced austenitic steels**
- for higher BU there is a wide convergence on the interest of **9-12Cr F/M steels** (however, upper temperature limit) and **ODS alloys** (e.g. Super ODS steels).

Primary loop for loop type reactor:

- Reduction in piping and elbows by using **9Cr F/M steel (e.g. mod. 9Cr-1Mo)** (Japanese demonstrator)

V/HTR

Two materials impose limits to system performance: IHX and vessel material.

- IHX → **Ni – based alloys**
- Hot Vessel option → **mod. 9Cr-1Mo**
- Short term: materials selected for Vessel and IHX need to be qualified
- Long term: development of new materials

Old Problems with New Eyes - Looking at New Problems with

Large databases from past experimental programs (e.g. EFR) should be made available and can be used for the development of modern theory supplemented with focused new data

Moreover, improvement in the performance of structural materials can be achieved with a science-based approach

Use of modern materials science techniques is valuable to uncover new phenomena (e.g. ultra-high strength alloys).

Cooperation to investigate phenomena and develop improved structural materials should be encouraged among fusion and the various innovative fission reactor programs.

The growing role of multiscale modelling has been strongly underlined.

I think that the interest and quality of the presentations, the discussion that we had during these three days have clearly confirmed that a number of relevant materials issues will play an important role in the feasibility and conceptual design studies of all the innovative systems which are presently under discussion with Generation IV, GNEP and within national programs.

The session chairpersons have given their first conclusions, and we will try **to shape a proposal to the Nuclear Science Committee for continuation of this activity.**

I see a number of objectives for e.g. an expert group within an existing working party or even for a new working party:

- 1. To organise this type workshop for information exchange, with a pace of ~ every two years. (e.g. topics proposed by F. Carré: Mechanical design rules, Assessment of structure integrity; Multi-scale modelling of materials & fuels; Synergies between Fission and Fusion materials)**

2. To establish an activity in the field of multiscale modeling and simulation and related experimental validation. E.g. a state-of-the-art, type of experiments, computational techniques, etc.
3. To perform state-of-the art assessment for specific areas to be considered as priority areas of research: e.g. ODS alloys, high Cr steels, Composites.
3. Establish reports on past experiments and future needs (F. Carré)
4. To put in common experimental databases (F. Carré , W. Dietz)
5. To agree on experimental protocols and standards; and share of available experimental installations.

However, this are very preliminary suggestions and we can use the time of discussion to evaluate and agree on some proposals for future activities.