6. FINAL REMARKS

The top-down approach discussed in this report is intended to be a general method for assessing the safety and developing safety requirements for the design of nuclear reactors taking into consideration the implementation of the principles of defence in depth. The method is applicable to any kind of reactor, however, how defence in depth is implemented and the implications on safety requirements are concept specific.

The application to MHTGRs, although very preliminary, proved that the method is viable and useful. The specific features of the MHTGR concept are significantly different from those of LWRs and they have great influence on the implementation of defence in depth.

Stronger provisions at Level 1 could reduce the requirements on monitoring and controlling at Level 2. Passive safety features at Level 3 reduce the requirements on active engineered safety features at the same level and enhance the overall safety performance. Design basis accidents are mostly dealt with by inherent features and passive systems. The large thermal inertia of the MHTGR enhances the effectiveness of Levels 2 and 3 of defence by providing very long times for systems and operator response and implementation of any mitigating measures. Needs for functional redundancies must be checked carefully through a deep and comprehensive analysis of the safety related architecture performance and reliability (PSA, for instance).

Quantitative comparisons between the safety performance of MHTGRs and LWRs could show that similar postulated initiating events could lead to accident sequences with lower consequences or probabilities of occurrence in MHTGRs than in LWRs. Of comparable importance is the potential that monitoring and surveillance requirements in Level 2 could be simplified or reduced in scope while providing an equivalent level of safety. The exercise also showed that areas such as the definition of success criteria for each Level of defence in depth and the integration of deterministic and probabilistic approaches need more investigation.

The MHTGR fuel characteristics indicate that for internal initiating events, severe accident scenarios involving core melt can be practically excluded although severe scenarios involving extensive oxidation of the fuel could be envisaged. Design provisions and accident management measures must be considered carefully for very unlikely external challenges, like severe earthquakes, floods or airplane crashes in the context of retaining the structural integrity of the core.

The methodology discussed here and illustrated by application to a general MHTGR concept will be used as basis for developing international safety requirements for advanced reactors comparable to those that have been developed for existing and evolutionary water reactors. Establishing these requirements will involve extended participation and review by Member States interested in the future deployment of advanced reactors and in particular MHTGRs.